THE
ELECTRICAL REVIEW

Volume CXXIX — No. 3333

Friday, October 10, 1941

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EDITORIAL, ADVERTISING AND PUBLISHING OFFICES: Dorset House, Stamford Street, London, S.E.1

Telegraphic Address: "Ageekay, Sedist, London." Code: A B C. Telephone No.: Waterloo 3333 (35 lines)
Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage. Entered as Second Class Matter at the New York, U.S.A., Post Office.

Subscription Rates, Postage free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £1 14s. 8d. per annum.

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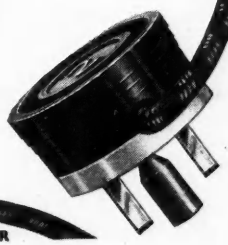

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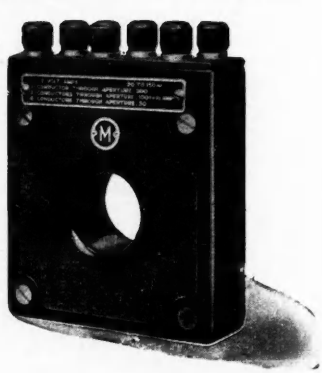

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THE
ELECTRICAL REVIEW
THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXIX. No. 3333. OCTOBER 10, 1941 6d. WEEKLY

Lighting and Production

Importance of Continued Study

WITH the complete prohibition of normal exterior lighting and illuminated shop windows and the severe curtailment of the supply of fittings for domestic use, discussions upon lighting nowadays revolve almost entirely about the factory. And indeed quite apart from the considerations mentioned this is the most important aspect of the subject, for good lighting is indispensable if maximum production is to be achieved.

Perhaps some readers will consider that the subject of industrial lighting has been stressed *ad nauseam*, but the last word has not yet been said. The studies of psychologists and oculists are constantly revealing new facts about the effects of lighting upon the human mind and eyesight—which means upon general well-being. At the same time improvements in lighting media and technique present further reasons for continued study and that is why we make no apology for paying special attention to lighting matters in this issue.

Mr. J. S. Dow deals with an important aspect of the illumination art—the "quality" of light. By employing a sufficient number of lamps of sufficient size it is an easy matter to conform to "foot-candle" requirements. The results may still be disastrous so far as the comfort of the worker and his level of output are concerned. As Mr. Dow points out, direct glare is dealt with by the new regulations but this is not the only undesirable effect to be guarded against. Indirect glare can be equally troublesome and too much light can be extremely trying to the eyes.

There was a time when the elimination of shadows seemed to be the ideal to be aimed at by illuminating engineers. It is now agreed that while objectionable shadows must be avoided an entire absence of shadow is not desirable, in fact it may produce monotonous and annoying results. If proper illumination at the working plane is secured it might be thought that the aim had been achieved. This is far from being the case as Mr. Dow emphasises when he says that "in the factory, as elsewhere, it is really difficult to dissociate lighting from decoration."

Both Mr. Dow and Mr. E. B. Sawyer put in a word for the fluorescent tube. There is no doubt that this has made possible a great advance in the lighting of large areas. It is not only much more efficient than the older types of incandescent lamps; it has a better "spread" and an emission approaching daylight. The last quality makes it particularly suitable for situations in which ability to distinguish colours is required.

But the gasfilled filament lamp is far from finished. It is still much lower in first cost—a fact which is bound to weigh heavily with most people until they are convinced that other advantages are of greater account. Moreover, the vast majority of the fittings available were designed for this form of light source and

are not adaptable to the new fluorescent tubes. Some time must elapse before these are rendered entirely obsolete.

In his survey of future prospects Mr. A. D. S. Atkinson goes further afield from the factory. He not only gives some consideration to the lighting of commercial premises, public buildings and the home; he also deals with the question of standardisation of voltages and fittings. The lighting engineer or contractor is the spearhead of the electrical thrust and he is consequently entitled to have a say in the arrangements by which electricity is supplied to his installations. Lighting was the means by which electricity first gained a foothold in industry and the home, and it is still the principal method of introduction.

Contractors' Interests

A CORRESPONDENT to the October *Electrical Contractor* complains that that journal does not pay sufficient attention to technical and allied matters of interest to electrical contractors and suggests a number of subjects which might be dealt with. Our contemporary ably replies to the charge, attributing the lack of such matter to the indifference of its readers who alone are able to provide it. But looking at the correspondent's list of possible subjects we cannot help remarking that most of them are regularly covered in our pages, and so we feel that while the *Contractor* continues to report so effectively the affairs of the Electrical Contractors' Association we can between us give the contractor all he wants.

American Transport Revival

THE hey-day of public transport in America, in the years immediately after the last war, was followed by a period of steady decline as the competition of the private car increased. Thus in one large town the number of passengers carried decreased from 110 millions in 1921 to 61 millions in 1933, in spite of a considerable growth in the population. Since then modernisation of the public transport facilities has induced a recovery in the number of passengers carried to some 75 millions. One small transport undertaking had, in 1933, reached the stage at which the directors were willing to sell the system for $37,000, the purchaser to assume all obligations. They were, however, persuaded to try modernising the equipment. To-day trolley-coaches are used exclusively. A $300,000 bond issue has been repaid, and the business has reached a point at which the selling price is in the neighbourhood of $1,000,000.

Substation Layout

So rapid has been the growth of demand for power from the 230-kV lines connecting the Coulee and Bonneville Dams with the nearest load centres that the designs of many of the twenty-five major substations have had to be modified several times during the construction period. Originally, according to the *Electrical World*, the engineers made the best guess, multiplied by two and added 50 per cent. This method having proved inadequate, a set of standard extensible substation patterns has been designed to include parts of steel structures, busbar pedestals, transformers and portable temporary control houses. Although the circumstances may be exceptional, the underlying idea is of universal application.

House of Presidents

As representing the productive ability of the country, the views of presidents of leading technical institutions acting in concert would undoubtedly carry more weight with the public than would those of isolated bodies. A suggestion made in the correspondence columns of the *Mining Electrical Engineer* is that a " House of Presidents " should be created to pool their ideas for the national future. The meetings of such a body need not be frequent as they would be concerned mainly with questions of co-ordination of procedure in order to present a solidarity of opinion. In order to avoid unwieldiness, however, the number of member-presidents would presumably be limited to one for each important industry.

A Visionary

IT is very desirable to take long views, but the end should always be in sight. We fear that this can hardly be said of a man at Sheffield, who, according to the *Daily Sketch*, " looks forward to the day when cars will be run on dry batteries." His optimism appears to be based on his discovery of a means of re-charging dry batteries—" large and small "—but, quite properly we think, he refused to allow his name to be divulged.

Industrial Lighting

The Welfare of the Worker

By E. B. Sawyer,
F.I.E.S.

The author, who is on the staff of the E.L.M.A. Lighting Service Bureau, discusses the physiology and psychology of factory lighting under wartime conditions

MUCH has been written on industrial lighting, as can readily be understood in view of its undoubted national importance, the Regulations made by the Minister of Labour and National Service, and the requirements of the Admiralty, Ministry of Supply, and Ministry of Aircraft Production, that lighting in supply factories shall be of a prescribed standard. Reiteration appears to be warranted in view of the slowness of some factory managements and some members of the electrical industry to appreciate the value and need of providing, not only sufficient illumination, but light of a quality which will compensate to some extent for the effort that industry to-day is putting into its task, and lighting of a kind which will provide as pleasant an environment as possible in the workshops of the country.

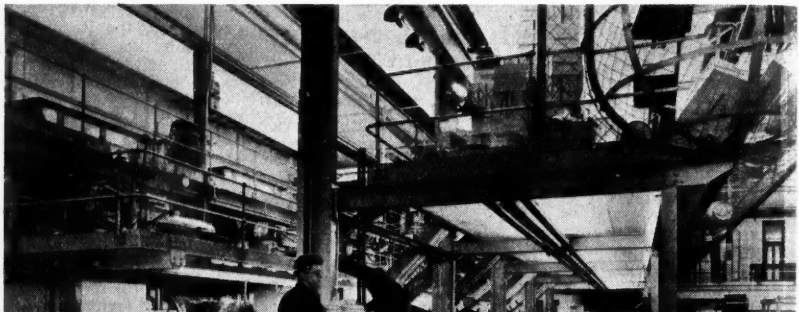
Of the total number of factories controlled by the Service Ministries, some 88 per cent. now have lighting of the prescribed standard or have been given expert advice on how it should be obtained. So far as the other factories and workshops in the country are concerned, the Regulations made by the Minister of Labour and National Service have been framed with a view to conserving supplies and the resources of the electrical industry for vital installations.

"Telescoping," and the fact that the Regulations apply to factories in which persons are being regularly employed in a process or processes for more than 48 working hours a week, or in shifts, has meant that probably not more than 10 per cent. of the total factories have to comply with the mandatory requirements of the Regulations, although all are compelled to provide lighting sufficient and suitable under the Factory Act, 1937. Broadly speaking, this means that all factories must have lighting which will ensure the welfare of the staff, reduce accidents, eliminate glare, and avoid the presence of dense shadows. Of the number coming under the Regulations comparatively few have so far taken steps to comply, although the tempo is likely to increase with the approach of darker days. Representations to the B.O.T. have resulted in supplies of materials for factory lighting under the Regulations being

With fluorescent lamps high levels of illumination can be obtained without the discomfort of excessive heat and dazzle, details are sharply defined and the colour is ideal for industrial interiors. An armature winding shop (Crompton Parkinson)

made available against an "M" form or a certificate from the Factory Department; the greatest difficulty now is finding labour.

With lighting, as with most other things, the war has taught us a great deal; from the last twelve to eighteen months has been obtained years of industrial lighting experience. Practice has justified and amplified the theories indicated by investigations and research into the value of good lighting. There are still many, hide-bound by past practice, who look aghast at the values of illumination recommended in the Illuminating Engineering Society's Code. Many others, both in this country and America, have, however, proved to their complete satisfaction that good high-intensity lighting is a production tool of the first order. Installations of 30 to 50 foot-candles are fairly common and, in some cases, looked upon as minimum values for fine work and inspection.



The value of lighting should not be based on its costs, but on its suitability. Repetition work loses much of its boredom if the surroundings are bright. Indirect lighting of a food factory by small flood-light projectors directed towards the ceiling

Physiological Factors

Illuminating engineering has progressed far beyond rule of thumb answers to all problems; physiological and psychological effects have to be considered more and more if the lighting installation is to satisfy the critical demands of war production. It is necessary to study the person whom the lighting is to assist and also to appreciate the task from his point of view, bearing in mind that he will be carrying on for many hours a day and for week after week.

In the process of seeing, sense elements in the retina pick up differences in brightness or colour and by means of the nerve system transmit a record to the brain. The sensitivity of these elements varies with the total amount of light which the pupil allows to enter the eye. If the differences in brightness of the various parts of the image are kept in the same relative proportion to each other but the overall brightness of the image is increased, the eye can detect these differences in brightness with greater ease. The eye, however, is not a perfect optical system, for the wider the opening of the pupil the less sharp are the outlines of the image. Therefore, to see fine detail in an object the pupil should be decreased in size. This is effected by increasing the overall brightness of the field of vision up to a limiting value beyond which no further decrease in size can take place.

When engaged on fine work with an illumination too low for comfort but enough to see by, the pupil is large, admitting as much light as possible to the eye, but the ability to distinguish detail is decreased and conflicting adjustments lead to eyestrain and attendant ills. As an example, if the original illumination on a task had been 1 ft.-candle and was then increased to 20 ft.-candles, the pupillary area would be decreased by one half, but the light entering the eye would be increased tenfold; thus a

double advantage would be gained in increasing the ability to see fine detail and also to detect small differences in brightness.

The great majority of industrial tasks involve seeing by light reflected from their surfaces; the appearance of the object, apart from form, shadow and colour depends upon the amount of light and the reflective properties of the object viewed. Thus, if the task were black stitching on white material, doubling the illumination say from 10 to 20 ft.-candles would double the brightness of the white material, but the percentage brightness difference would remain the same. If the task were black stitching on grey material, with a reflection factor of 40 per cent. the percentage brightness difference would not be much less, but it would be necessary to double the illumination to make the grey material as bright as the white material was at 10 ft.-candles. To see the two tasks with equal facility, still more light on the grey background would be necessary to compensate for the lower brightness difference, since increasing the brightness also increases the sensitivity of the eye to brightness differences.

Much might be done to increase production if more attention could be given to the eyesight of industrial workers. Men of advancing years, men and women with little industrial experience, as well as experienced operatives with sub-normal vision, form an ever greater proportion of the industrial army. Poor lighting conditions impose unnecessary strain on such workers, whereas good lighting results in reduced production costs, better quality products, and more contented personnel. It has been estimated that 87 per cent. of all impressions are obtained through the eyes, and whilst people with normal vision are assisted by the provision of levels of illumination up to quite high values (Lythgoe says in certain conditions up to 1,000 ft.-candles*), those with sub-normal vision receive even greater assistance when they are provided with good lighting.

Accidents

Industrial accidents may be prevented both by attention to lighting and to the eyes of the personnel. A recent investigation showed that increasing the illumination in a wartime factory from 5.7 to 13.5 ft.-candles decreased the accident rate by 58 per cent.

With normal vision it may be possible, even under low levels of illumination, to avoid an accident, whereas people with sub-normal vision would be seriously handicapped. The case of a crane operator who complained of headaches may be quoted as an example for the need for eye examination. It was found that his vision in each eye was perfect, but he suffered a marked muscle unbalance which was cured by orthoptic training. He stated that without judging by some stationary object he could not previously have told within 10 ft. how close to a spot his load would be dropped. After the cure he could judge a spot exactly, and consequently a potential source of accidents was eliminated.

Psychological Effects

Lighting is only one of the factors in the psychological well-being of employees. The Departmental Committee on Lighting in Factories in its Fifth Report drew attention to the desirability of keeping all surroundings as light in colour as possible. This not only increases the illumination derived from a given wattage but also relieves the depression noticeable in many factories. Not only should walls, ceilings, and " black-out " screens be light in colour, but as far as possible non-working parts of machines and structural members should be painted in light, and even gay, colours.

Windowless factories are not a wartime expedient, although the blackout and the vulnerability of glass to blast has greatly increased the number in existence. It is obvious that due attention will be paid to artificial lighting in those buildings designed without windows, but in those buildings where the windows have been obscured, advantageous results can be obtained from quite inexpensive temporary expedients to secure as natural and cheerful an appearance as possible, and thus provide the greatest psychological advantage to the workers, and ensure that eyestrain and depression do not affect their health and well-being. Some light deliberately directed on to the ceilings and upper parts of walls, by means of a small number of symmetrical or angle reflectors is advantageous, or alternatively, artificially-lighted windows in the walls or ceilings may sometimes be practicable.

A high efficiency source of light, closely resembling natural daylight, became available with the introduction of the 5-ft. fluorescent tubular lamp. Its low surface brightness and large area make it an admirable tool in the design of high-intensity lighting installations; by its use the illumination of large or small areas to values of 50 to 100 ft.-candles is brought within the bounds of sound illuminating engineering design.

Investigations in carefully supervised workshops have shown that lighting which seemed sufficient in peacetime has been the cause of complaints when the hours of use due to obscuration of the windows have had to be increased. Improving the lighting showed a marked improvement in the alertness of the workers towards the end of the day and removed the reluctance to work overtime. Within a week the demand for free time had subsided and the need for supervision was greatly reduced, as also was the general debility and fatigue for which the longer hours of work over several months had been blamed.

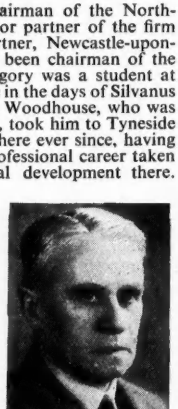
* The Measurement of Visual Acuity.

New I.E.E. Chairmen

Some Biographical Details

THE proceedings of the Institution of Electrical Engineers are now under way and therefore, following our usual practice, we propose to publish brief biographies of the chairmen of the local centres. Below we deal with the first four :—

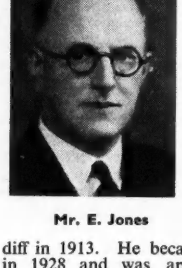
Mr. R. W. Gregory, chairman of the North-Eastern Centre is the senior partner of the firm of R. W. Gregory & Partner, Newcastle-upon-Tyne. He had previously been chairman of the Centre in 1925. Mr. Gregory was a student at Finsbury Technical College in the days of Silvanus P. Thompson. Mr. W. B. Woodhouse, who was then a lecturer at Finsbury, took him to Tyneside in 1901, and he has been there ever since, having during the whole of his professional career taken an active part in electrical development there.



Mr. R. W. Gregory

He was first employed as a junior assistant by the Newcastle - upon - Tyne Electric Supply Co., at its Neptune Bank power station and later at Carville "A" generating station. In 1903 he joined the staff of Charles H. Merz (later Merz & McLellan) as an assistant to Mr. Bernard Price. He remained with Merz & McLellan until 1933, and became their chief electrical engineer and a partner in the firm. He has travelled in the United States and on the Continent studying electrical development. In 1933, following a serious accident which kept him away from business for a considerable time, Mr. Gregory retired from active service with Merz & McLellan. He made a complete recovery, however, and founded the firm of R. W. Gregory & Partner, who practise as consulting engineers in the industrial field.

Mr. E. Jones, M.I.Mech.E., city electrical engineer and manager of Cardiff, is the new chairman of the I.E.E. Western Centre. Mr. Jones received his early training at the Cardiff Technical College, and with the Cardiff Electricity Department under Mr. A. Ellis, M.I.E.E., M.I.Mech.E., and Mr. C. G. Morley New, M.I.E.E. Later he had several years' experience in marine and colliery work before being appointed deputy mains superintendent at Cardiff in 1913. He became mains superintendent in 1928 and was appointed to his present position in 1935.



Mr. E. Jones

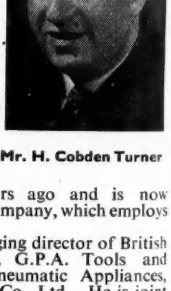
Mr. E. G. Taylor, B.Sc.(Eng.), engineer to the General Electric Company's Manchester and Liverpool branches, is chairman of the Mersey and North Wales (Liverpool) Centre. He is a native of Birmingham, and was educated at the King Edward VI Grammar School, Aston, and Birmingham University, obtaining in 1921 the B.Sc.(Eng.) degree in electrical engineering. He joined the G.E.C. in 1913 as an apprentice at the company's engineering works at Witton, and subsequently served at the Liverpool and Swansea branches, being appointed to his present position in 1939.

Mr. E. G. Taylor

He became a student member of the Institution of I.E.E. in 1920, an associate member in 1928 and a member in 1937. He served as a member of the committee of the Mersey and North Wales (Liverpool) Centre of the Institution from 1935 to 1938, and as vice-chairman from 1939 to 1941, also acting as organising secretary for the I.E.E. Benevolent Fund dance from the time of its inception. During the last war he served three years in the R.N.V.R.

Mr. H. Cobden Turner, J.P., M.Inst.C.E., chairman of the North Western Centre, was educated at Manchester Grammar School, Salford Technical College and the Manchester College of Technology, where he was awarded the diploma in electrical and mechanical engineering.

He was apprenticed to the General Electric Co., Ltd., at the company's Peel works, Salford, and also worked as experimentalist with Ferranti, Ltd. From there he went to the Electrical Apparatus Co., and founded that company's Meter Department. He left the Electrical Apparatus Co. to join the British Westinghouse Co. (now Metropolitan-Vickers) where he worked in the sales and meter engineers' departments. He joined the Salford Electrical Instruments, Ltd., as manager twenty-three years ago and is now managing director of that company, which employs nearly 3,000 workpeople.



Mr. H. Cobden Turner

Mr. Turner is also managing director of British Jewel Manufacturing Co., G.P.A. Tools and Gauges, Ltd., General Pneumatic Appliances, Ltd., and British Ferrocart Co., Ltd. He is joint author with Mr. E. H. W. Banner, of a book entitled "Electrical Measurements."

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE M.B.E. has been awarded to **Mr. A. G. Aves,** charge engineer in the Poplar Electricity Department, for bravery during an air-raid. When high-explosive and incendiary bombs fell around the power station Mr. Aves co-ordinated the activities of the staff in such a way that they saved the station from destruction and quickly restored the supply of electricity to a large area. Messrs. J. T. Everson, H. W. C. Griffin, W. E. Partridge and J. A. Wade, of the Poplar undertaking, have been commended.

Mr. E. Blackburn, assistant engineer in the Telephone Manager's Office at Liverpool, is among those whose names are published in the *London Gazette* as having received an expression of commendation for their brave conduct in Civil Defence.

Mr. W. Allcock

Mr. W. Allcock, who has been appointed chief engineer to Erskine, Heap & Co., Ltd., took up his new position on October 1st. His technical education was received at the Manchester College of Technology, and his training with Ferguson, Pailin, Ltd. After extensive experience on switchgear design with the English Electric Co., Ltd., A. Reyrolle & Co., Ltd., and Brookhirst Switchgear, Ltd., he was appointed, in 1935, chief switchgear designer with Crompton Parkinson, Ltd., in which position he has had considerable experience of short-circuit testing. He held this post until taking up his new duties.

Major-General C. J. S. King, M.Inst.C.E., has been appointed engineer-in-chief at the War Office, a post created to co-ordinate the planning and control of engineer work in the Army.

Mr. F. Stirling Coates, who has been appointed assistant to the manager of the Central Electricity Board (Central England Area), was district engineer and manager in the Alnwick area for the North-Eastern Electric Supply Co., Ltd., until May, 1939, when he became district manager at Leeds for the Yorkshire Electric Power Co.

Mr. C. Fagg has been appointed chief assistant to Mr. T. A. Chell, whose appointment to the position of engineer and manager to the Isle of Thanet Electric Supply Co., Ltd., was reported in our last week's issue.

Pilot Officer C. F. Rawnsley, who before the war was an engineer with the Hendon Electric Supply Co. (now controlled by the Northmet Co.), has been awarded the D.F.C. He also holds the D.F.M. and bar and is the first observer with a night fighter squadron to receive three decorations.

Mr. G. L. Wagstaffe, traction contract engineer, of the English Electric Co., Ltd., Bradford, has been appointed assistant rolling stock superintendent of the Huddersfield Passenger Transport Department, at a salary of £300 a year, rising by £25 a year to £400 a year, plus war bonus. **Mr. R. A. G. Truckel** (traffic assistant at Huddersfield) has been appointed assistant traffic superintendent at Huddersfield on the same terms.

Brighton Corporation Electricity Committee has appointed **Mr. S. Peachey,** junior shift engineer, as shift engineer at a salary of £428 per annum, in succession to **Mr. C. Payne,** who is retiring on superannuation after forty-three years' service.

Mr. W. R. Davies, who recently resigned on account of ill-health from the boards of Central London Electricity, Ltd., and the London Power Co., commenced his long association with the electricity supply industry in 1888 when he joined the board of the Brompton & Kensington Co. of which he later became chairman. He was also chairman of the Chelsea Company until the amalgamation of the London companies in 1937.

We regret that in our last issue we gave the name of Mr. L. Owens successor as mains superintendent, Charing Cross and City District, of Central London Electricity, Ltd., incorrectly. He is **Mr. W. A. F. Howard.**

Col. G. G. Mallinson, T.D., A.M.I.E.E., branch manager of Johnson & Phillips, Ltd., and a director of the Westmorland & District Electricity Supply Co., who has been a general staff officer attached to the Royal Air Force since August, 1939, has resigned on attaining the age limit.

Mr. H. H. Berresford, who has just been appointed managing director of the Staveley Coal & Iron Co., is a director of several electricity supply companies, including those at Eckington, Barlborough, Staveley, Brimington and Clowne.

Mr. R. J. Norton has, for health reasons, retired from active duty with Petters, Ltd., after twenty-five years' service, but remains a director of the company. In addition to his long association with the oil-engine business of the company, he was intimately connected from its inception, with the development of Westland aircraft, which formed a branch of the company's activities for many years. Tributes to Mr. Norton's business ability and philosophical outlook were paid by Mr. A. P. Good, deputy chairman of the Brush Electrical Engineering Co., Ltd. (with which Petters, Ltd., are associated) and Captain R. C. Petter, director and a colleague of Mr. Norton, when presentations were made on behalf of the directors and staff.

Mr. R. J. Norton

Sir Ernest Benn, chairman of Benn Bros., Ltd., publishers of a number of journals including our contemporary the *Electrician,* has resigned his

position on account of pressure of other business, and **Mr. Gordon Robbins** has succeeded him.

Mr. W. J. Jones, director of the Electric Lamp Manufacturers' Association, the new president of the Illuminating Engineering Society, is to deliver his presidential address at the opening meeting of the Society at the Lighting Service Bureau on October 14th.

Mr. T. M'Greevy, B.Sc., assistant in the department of electrical engineering and mathematics at Dundee Technical College for four years, has resigned on being appointed head of the electrical section of the engineering department at the Municipal Technical College, Oldham.

Mr. A. E. Dent, A.M.I.E.E., who has been appointed a magistrate for Nelson, Lancs., is in business as an electrical engineer and contractor.

Councillor H. W. Barber, the new Mayor-elect of Southport, is branch manager at Manchester for Johnson & Phillips, Ltd.

Mr. M. Bannister, senior switchboard attendant, has been appointed additional control engineer at the Huddersfield power station.

Mr. A. E. McColl is to give his inaugural address as chairman of the Scottish Centre of the I.E.E. in Glasgow on October 14th. The address will be repeated next day in Edinburgh.

The Chartered Institute of Secretaries reached its jubilee on October 1st, but on account of the war the event had to be celebrated on a less imposing scale than would have been the case in normal times. The President, **Mr. Leslie Gamage** (G.E.C.), gave a private luncheon to the members of the Council when messages were received from the King and the Prime Minister. Mr. Gamage proposed the toast of the Institute, to which Sir George Broadbridge, M.P. for the City of London, and Sir Edward Wilshaw, head of Cable & Wireless, Ltd., responded.

Mr. E. W. Moss, the hon. secretary, tells us that his committee has arranged a luncheon for The Dynamicables at the Café Royal, Regent Street, W.1, on October 22nd. Sir Noel Ashbridge, chief engineer of the B.B.C., will take the chair and Mr. Johnstone Wright, chief engineer to the Central Electricity Board, will propose the toast.

Mr. G. H. Tilly, B.Sc., assistant superintendent for lifts and escalators, has retired from the service of the London Passenger Transport Board owing to ill-health. He is succeeded by **Mr. I. W. Standring,** A.M.I.E.E. **Mr. E. T. Brook,** superintendent of rolling stock (railways), has relinquished his railway responsibilities, but is retaining responsibility for the Board's Home Guard unit, of which he is colonel, and Air Raid Precautions. He will be available for any advice in connection with railway matters. **Mr. A. W. M. Mawby** has also been released for whole-time duties with the Board's Home Guard unit. **Mr. J. A. Wilks,** at present second assistant superintendent of rolling stock, has been appointed acting superintendent of rolling stock (railways) and has been relieved of A.R.P. and other special duties upon which he has been engaged.

Mr. Tilly, who obtained the B.Sc. degree with honours at the University of London from the City & Guilds Central Technical College, had experience with the Cardiff tramways, the British Thomson-Houston Co. and at the Wood Lane power station, and in 1911 was appointed assistant draughtsman and chief tester of the Adelaide (South Australia) Municipal Tramways. He joined the London Underground Railways in 1919 as technical assistant (lifts) and in 1936 he was appointed assistant superintendent.

Mr. Standring received his early engineering training at Pembroke College, Cambridge, and Faraday House, and later he entered the works of the General Electric Co. During the last war he obtained a commission in the Royal Engineers and in 1924 joined the Underground Railways as an engineering cadet. In 1926 he joined the staff of the Union Construction & Finance Co., engaged in the construction of trams, trolley-buses and rolling stock for the Underground Railways. In 1932 he became engineering assistant to the mechanical engineer (railways) at Acton, and in 1938 was appointed personal assistant to the assistant superintendent of lifts and escalators.

Mr. Wilks was apprenticed to Crompton & Co., Ltd., and subsequently became assistant to the works manager of Mountain & Gibson, tramway and railway engineers. He joined the Metropolitan Railway in 1911 as superintendent of mechanical and electrical repair shops. In 1939 he was appointed second assistant superintendent of rolling stock and A.R.P. officer. In 1940, in addition to these duties he was personal assistant to the chairman of the A.R.P. Committee.

Obituary

Mr. G. Balfour.—A memorial service to the late Mr. George Balfour was held at St. Margaret's, Westminster, on October 2nd. Among those present were Mrs. George Balfour (widow) and Capt. H. G. Balfour, Mr. D. M. Balfour and Lieut. I. M. Balfour, R.N. (sons). There was also a very large gathering of distinguished electrical men representing practically all branches and associations of the profession and industry as well as a number of fellow Members of Parliament.

Mr. G. C. Gray.—We regret to record the death in Anglesey of Mr. G. C. Gray, lamp superintendent of the Metropolitan-Vickers Electrical Co.'s Birmingham office. Mr. Gray's technical experience was gained at the Birmingham Technical School, and from there he went to the Simplex Electric Co. in 1908, joining the Metrovick organisation in 1923.

Mr. W. E. W. Beerling, formerly commercial manager to the Carron Company and general manager of British National Electrics, Ltd., has died in India, where he was a lieutenant in the R.A.O.C.

Sir John Hewett, G.C.S.I., K.B.E., C.I.E., who died on September 27th, at the age of 87, was a member of the Board of the General Electric Co., Ltd., for many years.

Mr. J. Booth.—The death occurred on September 25th, at the age of eighty-five, of Mr. John Booth, of Belfield, Windermere, who was for several years chairman of the old National Electric Supply Co., Preston.

Sir Herbert Holt.—The death is reported from Montreal of Sir Herbert Holt, the Canadian financier who was founder and for forty years president of the Montreal Light, Heat and Power Co.

Mr. A. B. Coussins, charge engineer in the Hammersmith Electricity Department, died on September 30th.

Quantity and Quality

Human Factors in Industrial Lighting

By J. S. Dow

Hon. Sec., Illuminating Engineering Society

IN an article about two years ago I reviewed regulations bearing on industrial lighting and attempted to answer the query "How much light do we need?"* In the present contribution I have been asked to deal with the supplementary inquiry "What quality of light do we need?"—a much more difficult task because quality, even more than quantity, varies according to the purpose for which it is intended, besides being so much more difficult to specify with precision.

Some attempt to answer this question in one of its aspects was made about a year ago,† and it may be well to recall briefly some of the main conclusions then presented. On that occasion I was concerned primarily with wartime industrial lighting and the Factories (Standards of Lighting) Regulations. In the present article I propose to consider the problem on a somewhat broader basis, bearing in mind the conditions, both at the present moment and in time to come.

The provision of the correct amount of lighting is an easier matter than making sure that the light is "right." Mr. Dow, in stressing this, deals with some of the imponderables involved in the problem

From the very commencement of efforts to draft legislation on factory lighting the experts were conscious of this twin problem. The first Report of the Departmental Committee on Lighting in Factories and Workshops, issued in 1915, recommended the requirement of "adequate and suitable lighting" and ever since the distinction between "adequacy" and "suitability" has been preserved. It was quickly accepted that the best method of specifying adequacy was in terms of the illumination provided, either on ground level or on an assumed horizontal working plane, which was expressed in ft.-candles. The standard of adequacy visualised has risen progressively up to the present minimum of 6 ft.-candles, figuring in the present Regulations, with the so-called "I.E.S. Code of Recommended Values" in the background.

Avoidance of Glare

The definition of "suitability" presented more difficulty. Direct glare from light sources, imperfect diffusion (as exemplified by troublesome shadows) and unsteadiness or flickering of the light-source were early recognised as the three adverse conditions. In the case of glare it has been found possible to impose conditions, in the form of limits to brightness and the location of light sources, which certainly go far towards eliminating the worst abuses. Physiologists, when appealed to by illuminating engineers, have never been able to devise a direct and speedy method, based on observation of the reactions of the occupant of a room, by means of which it could at once be determined whether a lighting system is glaring or not. All that is possible, threefore, is to adopt an inferential or indirect method, *i.e.*, to forbid certain conditions or arrangements of lights, which are believed to have the effect of dazzle on the average eye.

We come here upon another difficulty—the personal element. Even amongst illuminating engineers, who understand well what is meant by glare, personal impressions of the extent of glare in a given installation will often vary considerably. How much greater, therefore, are the variations to be expected in the impressions of persons who are not lighting experts, and have not yet learned to analyse their impressions and who do not fully understand what to "look for in this direction."

Successive Departmental Committee Reports on Factory Lighting have not sought to define precisely the degree of flicker or unsteadiness which is permissible in light sources or to prescribe the conditions of shadow which are objectionable or the reverse. The Fourth Report, for example, merely directs that adequate means shall be taken to prevent shadows which "interfere with the safety or cause discomfort to workers," and that no flickering sources of light which, owing to flickering or inconstancy, interfere with safety or efficiency, shall be used.

Definition of Shadow-Conditions

The question of flickering light is now perhaps rather an academic one, except in so far as stroboscopic effects caused by discharge lamps are concerned, and these can readily be avoided. But the definition of shadow-conditions, on which the quality of lighting so largely depends, is a real problem. Some progress in this direction has been made by Dr. Teichmüller and other investigators, but it would perhaps be correct to say that the technique has hardly been developed sufficiently for adoption in official recommendations.

Similar remarks apply to what is sometimes

* ELECTRICAL REVIEW, September 8, 1939.

† ELECTRICAL REVIEW, January 17, 1941.

referred to as "indirect glare," *i.e.*, the troublesome effect of reflected images of bright sources of light formed on highly polished surfaces. The tendency to create such "glitter" is really a most important quality in modern lighting installations. Yet in framing regulations it is found impracticable to do more than emphasise its importance and suggest a few general precautions for its avoidance.

Mounting Height

It has frequently been pointed out that official regulations are so framed as to be met without undue difficulty and, therefore, necessarily cannot specify ideal conditions. As an instance we may take the existing requirements with regard to glare, requiring a limit in respect of brightness or cut-off when lighting units are mounted at a height of less than 16 ft. above floor level. Admittedly, compliance with these conditions goes a long way towards eliminating glare—yet it cannot be denied that the permitted display of unduly bright lights at heights greater than this may cause discomfort and, indeed, a caution to this effect is given in the Fifth Report of the Departmental Committee. Similarly, whilst the conditions prescribed do help considerably towards checking troublesome reflected glare it cannot be said that they entirely eliminate its possibility.

A good deal is still left, therefore, to the judgment of designers of lighting installations who should aim at a quality of lighting if possible in advance of that demanded in official regulations. It is fortunate that the conditions desirable with a view to diminishing glare are also those which help to mitigate troublesome glitter and inconvenient shadows, as well as being those inherently most suitable for the carrying out of the great majority of industrial operations. There are admittedly processes of inspection and production which demand the use of unilateral lighting or light coming at an oblique angle and from a source of small dimensions in order to reveal texture of or irregularities on the surface of the material. Such processes as work on embossed leather and on certain textile fabrics and fine engraving have been mentioned as instances. But there are not very many of these exceptional processes and their needs can usually be met by some form of local lighting, supplemented by general diffused illumination of lower intensity. The same applies to processes involving exacting work on very dark materials, for which intense illumination from shielded lamps situated very close to the work may be found advantageous.

Diffusion

The great majority of industrial operations demand well-diffused lighting, *i.e.*, a system in which the light is emitted from sources of relatively low brightness and great superficial area and strikes the object from different directions. This condition is attained primarily by adopting sources which are themselves of low brightness, or whose brightness is diminished to a relatively low value by means of diffusing glassware. It is also greatly assisted by making use of reflection of light from walls and ceilings, which themselves become secondary sources of great expanse and low brightness.

The effect of such measures is beneficial in several ways:—(1) In reducing direct glare because all sources are of low brightness or, even if rather bright, are seen against a background of moderate brightness which lessens the contrast; (2) in diminishing reflected glare —again because the images of light sources seen in polished surfaces are of low brightness, and because any trying effect they may have on the eyes is mitigated by the moderately bright background; (3) in softening the outlines of shadows, so that the troublesome effect of any shadows that may be cast on the work is less evident; and (4) in enabling the light to penetrate into apertures, spaces under tables or machinery or within the actual mechanism of complicated machinery.

It will be seen, therefore, that one goes a considerable way towards satisfying requirements in regard to "suitability" when the sources of light or lighting fittings are of low brightness and of large superficial area, and the surroundings are also light in colour.

Colour Distinction

There remains one consideration of moment, *i.e.*, the question of colour. Certain processes (dyeing, the grading of hops and tobacco, colour printing, for example) involve accurate colour matching and for these a precisely designed system of artificial daylight is necessary. There are also operations, such as the separation of dross from coal or ore, where light sources of some distinctive colour may prove advantageous in serving to magnify colour differences between an object and its surround. But apart from these specialised processes it may be said that, broadly speaking, a quality of light approaching daylight in its visual effect is generally advantageous in industry.

Almost invariably there is *some* advantage in being able to distinguish and recognise shades of colour fairly well. There is also some ground for believing that, owing to the want of achromatism of the human eye, a white light is preferable to a somewhat yellow one so far as distinctness of close vision is concerned. Finally, there is the important advantage, especially valuable in these days, when a combination of natural light and artificial light in blacked-out factories is so usual, of having a quality of light that mixes well with daylight.

The immediate success of the recently introduced fluorescent tube is due to the fact

that it combines with high efficiency the qualities of low brightness (of the order of 3 candles per sq. in.) and visual resemblance to daylight. Even the length of the tube (about 3 ft.) is advantageous from the standpoint of suitability in that it results in a source of relatively high superficial area, casting soft shadows. There has been a disposition to meet all problems by mounting such tubes immediately above machines, furnishing a species of localised-general illumination. To the writer this practice is not quite satisfactory because it does not enable full advantage to be taken of light surroundings, and also because it is apt to produce a somewhat unsightly effect. When the tubes are mounted well overhead and their effect is accentuated by mounting them in reflectors of exceptionally great superficial area, so that the degree of diffusion is still further enhanced, the results are both effective and pleasing.

This leads one to refer to another element in "suitability," which has come into prominence since the outbreak of war, the psychological effect of the system of lighting adopted. In addition to its fitness to enable a task to be done the quality of a lighting installation in creating a favourable mental impression deserves consideration, especially when long hours have to be worked at high pressure.

Relieving the Surroundings

This point was emphasised in the Fifth Report of the Departmental Committee. Allusion was made to the tunnel-like and depressing effect of installations in which a high illumination on the working area is combined with obscurity overhead, particularly in completely blacked-out factories where such conditions prevail during the day as well as in the night time. The value of some admission of natural light in relieving this drawback during the day, and the utility of light-coloured surroundings in producing a more natural effect both by day and night is well established.

Another drawback of strong overhead direct lighting, combined with dark surroundings, has been recently mentioned by Mr. E. W. Murray—the tendency for illuminated dust particles to become unduly evident, with the result that workers are apt to form the impression that the room is badly ventilated and to raise complaints. This effect would be less in evidence with fully diffused lighting and a lighter background to the room.

There can be little doubt that in the future more consideration will be paid to the general appearance of illuminated industrial interiors, as distinct from the value of the light in its primary purpose of enabling work to be done. The point was well made by Mr. H. C. Weston in a recent address to the Illuminating Engineering Society. He remarked that the workman was always a "whole man," who needed good lighting, not only as one of his tools, but as a condition of well being. The distinction between industrial lighting and other spheres of lighting, in which due regard is paid to decorative effect, is likely to become less clear-cut in time to come.

Already progressive firms are doing so much for their workers beyond the mere provision of facilities for efficient work that the idea of making a workroom a pleasant place besides a useful one should not be dismissed as visionary. The problem is not unlike that of the schoolroom which, in a modern building, is invariably a vastly more agreeable place than that provided a generation ago. As a result the outlook of elementary school children has been entirely altered, and the majority of them to-day regard going to school as anything but a hardship.

In the factory, as elsewhere, it is really difficult to dissociate lighting from decoration. Excellent results may often be obtained by quite simple means. I have in mind a small factory hastily assembled in a reconstructed building, by no means ideal for the purpose, partly shadowed by neighbouring trees and with poor access of daylight. The interior of the whole building has been redecorated, with walls and ceiling in light cream, and rafters and panelling picked out in blue. The effect, alike by natural and artificial light, is most cheerful and pleasing.

It is naturally more difficult to define quality of lighting than to tabulate values in foot-candles. The attempt should, however, be made and no doubt this will be taken into consideration in the final edition of the Recommended Values of Illumination of the Illuminating Engineering Society, the co-called "I.E.S. Code," now in process of revision. This extension of the Code might well form an important feature in the Society's work of post-war reconstruction.

Detecting Trapped Persons

APPLICATION was recently made to the London Region Commissioners by the St. Pancras Emergency Committee for approval of the purchase of sound amplifying apparatus to assist in the location of persons trapped in debris. The Committee was informed that until a decision had been arrived at the purchase of the equipment could not be approved, and at the last meeting of the Council it was reported that no intimation had yet been received from the Commissioners as to what conclusions they had come to in the matter. The Committee, however, was pleased to report that Post Warden Rogers had been carrying out experiments with sound amplifying apparatus, and had been assisted by technicians of Carmo, Ltd. A thorough test of the apparatus devised by Mr. Rogers was carried out and proved to be very successful. The Committee had therefore authorised expenditure up to £25 in the manufacture of this apparatus. It considered that the greatest credit was due to Mr. Rogers, who had displayed initiative and public spirit, and to Carmo, Ltd.

RECENT INTRODUCTIONS

Notes on New Electrical and Allied Products

Simplified Cable Marking

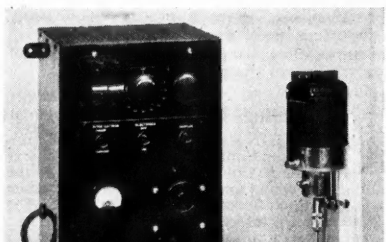
A NEW type of cable marker produced by the VISCOSE DEVELOPMENT CO., LTD., Woldham Road, Bromley, Kent, is certain to be appreciated by the electrical and associated industries. Requiring no special tools, these "Viskrings" as they are called are simply seamless, tubular sleeves of cellulose material which are supplied immersed in a solution (usually of very weak carbolic, which is quite harmless). The sleeves are made large enough to slip easily over the cable to be marked, but having a shrinkage factor of about 25 per cent. cling tightly round the cable when dry. The drying takes only a short time but can be accelerated by putting the cable in a current of air.

Unlike rubber sleeves, "Viskrings" are imperishable, are impervious to oils and petrol, and do not alter the diameter of the cable. All colours and sizes are available, with any desired printing, which is indelible.

A number of "Viskring" sleeves used on a multi-core cable and (right) sleeve being slipped on

Metal Analyser

Gravimetric analyses are a most convenient means of investigating the metallurgical composition of alloys. Such electrochemical methods are not confined to the determination of one metal only in the presence of others. Available procedures are elegant and varied, including analysis by graded potential, internal electrolysis, separations by complex-formation, micro-electrochemical analysis, etc., several hundred estimations daily being possible with the aid of the latest apparatus offered by GRIFFIN & TATLOCK, LTD., Kemble Street, London, W.C.2.



Gravimetric electrochemical analysis apparatus

This consists of a cast metal bench stand supporting an inverted universal motor rated at 1/30 HP continuously, which is acid and fume proof and is fitted with ball bearings and a switch. The vertical shaft terminates in a stainless steel chuck with ebonite collets and a glass paddle stirrer situated in the inner pair of Fischer-type platinum electrodes, held in adjustable clamps mounted on the motor casing. The swing-out support for the beaker to contain the solution is equipped with a 250-W element for heating and the hotplate temperature can be automatically regulated.

All metal parts are either vitreous enamelled or rhodium plated to resist acid spray corrosion. Energy is derived from a transformer feeding a metal rectifier of the selenium type, in a separate metal case for wall or bench mounting. The primary winding is tapped for 200/250-V AC mains input, delivering a DC output up to 6 A at 12 V. Switches are inset for the hotplate element and for controlling and reversing the electrolysing current, enabling the outer electrode to be alternatively used as anode or cathode. Main switch, DC fuses, ammeter, and rotary rheostats for motor speed and current adjustment are provided. The total loading approximates to 400 W.

Several individual outfits may be mounted together in a floor standard frame, each electrode pair in the rectifying system remaining electrically independent of the others.

Merchandise Marks in South Africa

THE *Board of Trade Journal* reports the suspension of the operation of Section 9 of the Merchandise Marks Act, 1941, which requires that goods imported into the Union of South Africa on and after October 18th, which are marked or labelled in the English or Afrikaans language, shall bear an indication of the country of origin.

Lighting in Reconstruction

Points for Immediate Consideration

By A. D. S. Atkinson

IT is generally accepted that things will never be the same again as they were before the war, and while this is a matter for regret so far as many of our previous activities and practices are concerned, there was a good deal of room for improvement in others. National reconstruction after the war will, if we are energetic and persistent enough, give us the opportunity to remedy some of the present inconsistencies of electricity supply and usage, and to ensure that the electrical services of buildings or specified areas shall be on a scale adequate for reasonable requirements.

The electrical industry will probably be in a better position to satisfy the demand for new lighting than for any other branch of electrical engineering, since the black-out has demonstrated to the public the value of light, while there will undoubtedly be a wide selection of fluorescent lamps in various sizes and colours very shortly after the war ends; and the high efficiency of these lamps means that it is possible to raise the standard of lighting without incurring any increase in the total cost of light. Whether a sufficient proportion of expenditure is at present allocated to artificial lighting is another matter altogether.

The author stresses the need for a measure of compulsion in order to secure reasonable standards of illumination. This leads him to advocate an improvement in electricity supply conditions generally

Need for Control

It will not be to the disadvantage of the general public if everyone is not to be permitted to do just as he pleases. The almost complete freedom of thought and action we enjoyed before the war has resulted in altogether too many different bodies or individuals making their own decision as to what electrical services they shall have, and thus perhaps sentencing fellow citizens in their employ to months and years of unsuitable working or living conditions. It should not be possible to do this, any more than it is to install unsuitable drains (assuming proper drainage facilities exist).

For years the country has been governed by Ministries which seldom make laws, but which are prolific in the issue of recommendations and other hopeful treatises on a variety of subjects, but compliance on the part of the public is neither compulsory nor, often, even likely. A little compulsion in some matters would do all of us good, provided the requirements with which we have to comply are reasonable, and are drawn up with the assistance of people who know what they are talking about.

The health and comfort of the population in peace is hardly less important than the welfare of industrial workers in war; legislation has already been passed to regulate factory lighting conditions with a view to preserving the latter, and it should therefore not be unreasonable or impossible to devise legislation which will do the same for the former. So widespread will be the use of light, however, that it is only possible to indicate here some of the principal fields of application, with brief suggestions for their lighting treatment.

Schools

As long ago as 1937 the Board of Education issued recommendations for the lighting of elementary school buildings, but it is doubtful if any educational authorities have followed the advice given therein, which in fact was closely in accordance with the recommendations of the I.E.S. Code. Ten ft.-candles at desk level was asked for; and yet it is quite certain that the majority of elementary schools have not more than four ft.-candles, many of them even less than two. And this state of affairs, which simply invites eye trouble and hinders the pursuit of knowledge, will undoubtedly persist if the matter is left in the hands of functionaries with a sharp eye on the local budget but a dim realisation of the result of their parsimony. Education may or may not be completely under Government control after the war, but at least it should be impossible for parochial or private interests to subject youngsters to poor conditions which may affect them for the rest of their lives, but about which they are unlikely to complain at the time.

Commercial Premises

Commercial consumption of electricity is certainly not going to decrease, and it is hardly likely to remain at a steady value. Buildings erected soon after the war will be quite out-of-date a few years later, so far as their electrical services are concerned, unless provision is made, first, for an installation sufficient for the immediate requirements, and secondly, for enlarging the installation as and when necessary. Perhaps it would be as well for the original installation to cater safely for double the original estimated load.

There may be other means of achieving this end, but it would appear to be necessary to

compel adherence to a minimum code of electrical (or gas) facilities drawn up by the two industries concerned, acting in co-operation with the Ministry of Works and Buildings. Further, so far as the lighting is concerned, it would probably be necessary to stipulate that the main lighting installation should be designed at the same time as the building itself and not relegated to the class of items to be discussed later, such as the colour of wall distemper and the quality of the lino.

Apart altogether from the business-getting value of floodlighting and signs, they can, if properly controlled, be definite assets from the æsthetic point of view. Local by-laws usually exerted some sort of control, but mostly referred only to minimum height and maximum projection over the pavement. Signs became so profuse that the result was sometimes complete confusion, traffic signals became unnoticeable and individual messages almost impossible to decipher among the riot of colour. We should certainly advocate nothing to limit the proper and reasonable employment of lamps; but with some things ill-considered excess leads to blurred vision and a subsequent headache.

Reinforced concrete buildings planned and erected shortly before the war were usually designed with some consideration being given to the use of floodlighting, and we hope this tendency will grow and develop. As a passing thought, will all damaged buildings be demolished or repaired? Would it not be worth while to preserve some of our damaged historical buildings in their present state of disrepair, and to floodlight them as a permanent reminder of what will certainly occur again if we fail to win the peace after the war?

Domestic Premises

It is to be supposed that some steps will be taken to avoid jerry-built, ill-planned, inadequately equipped " desirable residences " being erected irrationally and in large quantities as after the last war. We ought by now to realise that a house is something more than an enclosure containing furniture and the usual offices. It is a place to be lived in, not merely a place in which to exist. That being so, there ought to be a certain standard of comfort, built-in so to speak, for us to make use of if we desire.

The Joint Standing Committee of the electrical industry has prepared a minimum schedule of wiring points for two different sizes of house, with a total floor area of less than 2,000 sq. ft. This schedule has also the support of the R.I.B.A., and would therefore seem to offer an excellent groundwork on which could be based regulations designed to ensure that house occupiers shall not be deprived of the opportunity of using modern amenities simply because the cut-price policy of the builder necessitated cutting expenses to the bone.

In this connection, the writer has some knowledge of an " evacuation cottage " containing electric light, cooker and water-heater, but *no* plug points and the itch to do something rash with pieces of flex and multiple adaptors is at times rather difficult to suppress. If the activities of the amateur wireman are to be checked it would seem at least reasonable to remove some of the temptation from his path.

There will be an urgent and insistent demand for inexpensive lighting fittings, as distinct from the cheap and nasty variety. Recognised fittings manufacturers wishing to do business with 90 per cent. of the population would therefore do well to think seriously of producing reasonably cheap, robust and electrically safe fittings giving a good quality of light; the simpler the better.

Public Buildings and Churches

There are already specifications and recommendations for the lighting of many public buildings such as hospitals, museums, libraries, public halls, clinics, etc. Such buildings are usually under the control of local authorities and vary widely in many characteristics, but one at least they have in common, and that is lack of light. Entering one of these places for the first time seems like entering a prison, or what we imagine a prison atmosphere to be—cold, draughty, gloomy and depressing. Much the same might be said of many churches, though the religious reasoning which demands semi-darkness is beyond the understanding of most of us; if it is a shortage of cash locally there would seem to be a lack of proper organisation somewhere.

Unreasonable interference with church affairs would naturally be resented, but it is reasonable to ask that the public, *i.e.*, the Government, shall have some say at least in the lighting, heating and other necessities of a like nature for churches built or rebuilt partly or wholly by public funds. Local authorities should be under the same obligation with respect to all public buildings under their control.

Standardisation

It would be indeed a difficult task to compute the loss to the country as a whole caused by the present lack of standardisation in matters electrical. Manufacturers are put to quite unnecessary trouble and expense in making electrical machinery and appliances to suit all the 15 different " standard " voltages from 100 upwards, besides which there is a further large number of " standard " voltages down to 25. The distribution of population after the war is unlikely to become stabilised until many years have elapsed, if ever; and there are few factors more likely to discourage buying of such things as domestic electrical appliances than the fear that they may be useless in another area to which a move may quite likely have to be made.

Any sweeping standardisation carried out in an industry the size of our own is bound to

raise all sorts of difficulties and to upset, or at least give cause for concern to, a number of persons and organisations. It is suggested, however, that while we have the chance we should give very earnest consideration to the many and varied problems involved, of which a few are noted below.

The present multiplicity and the extreme complication of some tariffs would be laughable if it were not so serious. The little man always wants to know why he has to pay 5d. for his lighting units while someone across the road is apparently getting exactly similar units (although not necessarily for lighting) for ½d. or so. We all know there is a perfectly good commercial reason for such variations, but that is not to say that there is also a perfectly good ethical one.

Supply voltage, of course, should be standardised, and quickly, and there should be one standard, not fifteen.

Lamps, portable fires, irons, toasters and similar articles will never be used as freely as they might be until houses have plug points to connect them to. May we have our plugs and sockets compulsorily standardised—flat or round pins, but not both; three pins or two, but not both; and only, say, two sizes, *i.e.*, 15 A and 5 A; and the sale of all others prohibited.

Will very earnest thought be given to the issue of wiring *rules*, not recommendations; but will equally earnest thought be given once more to the question of steel conduit, which appears to be electrically safer than it really is, and which by its very nature increases the difficulty and cost of any desirable wiring alterations or additions?

These questions and a large number of others will have to be settled at some time. Meanwhile it is of the greatest importance that the entire electrical industry shall first find out what it really wants to get done, and shall then set about finding ways and means of getting it done.

The war may yet last for a very long time, and no one knows for certain with what state of affairs we shall be confronted at the end of it, but the Committee being set up for the purpose of considering these and like matters will also need considerable time even to reach agreement on the major problems involved. Beyond that they can hardly be expected to go at present; consideration of minor details of a political or technical nature will obviously have to be left until it is possible to obtain a clearer idea of post-war economic conditions.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Supply Reorganisation

THE correspondence columns of your journal have of recent weeks been utilised to ventilate many grievances against existing salary scales in the electricity supply industry. Furthermore, I note that in the REVIEW of September 26th no less an authority than Mr. R. A. S. Thwaites contributes an article, pointing out the anomalies of the present statutory requirements relating to grid charges.

Surely the industry would be well advised to put its house in order, otherwise there will be nothing for it but complete nationalisation which many of us do not want. Unified control would certainly simplify the question of tariffs, and would no doubt establish a graduated salary scale for all in the industry, not excluding the present chief engineers who would probably become regional engineers.

Incidentally, one of the largest municipal undertakings, and one of the largest of the power companies have not yet adopted the N.J.B. salary scale and conditions. In view of the Worthing decisions cannot the Government bring all undertakings into line under the powers conferred by the Essential Work (General Provisions) Order, 1941, which has been applied to individual undertakings?

Liverpool. "TWENTY YEARS A READER."

The E.P.E.A. and the T.U.C.

I SHOULD like to thank you for your timely leaderette relating to the proposed ballot for the affiliation of the Electrical Power Engineers' Association to the Trades Union Congress. The urge contained therein, inviting members of the Association to give very careful consideration before exercising their votes, is one that cannot be too strongly emphasised.

The points of view put forward, whether for or against, should be welcomed by all members of the Association to assist them in arriving at a proper decision. It is unfortunate that in these times of national stress and strain, this domestic matter should have again been raised.

The very conditions arising as a result of the present disturbed nature of things may well lead to a ballot, which will not by any means represent the opinion of the majority of the Association.

These conditions will debar certain members of the Association who are serving with H.M. Forces from exercising their votes on a matter which may be vital to their future, and which is undoubtedly vital to the future of their Association.

Leeds. R. TOYNBEE,
Past President E.P.E.A.

E.P.E.A. and T.U.C.

Members' Ballot on Affiliation

WHAT is described as "an issue of exceptional importance" is being decided by the members of the Electrical Power Engineers' Association. They are being asked to vote upon the question of affiliation to the Trades Union Congress. A memorandum for their guidance has been circulated with the ballot paper.

In the first part, dealing with the origin and functions of the Congress, it is stressed that it has no power over the internal organisation of affiliated unions and no authority to initiate drastic action. Its functions are largely advisory. The T.U.C. cannot intervene in a dispute between unions and employers, or between unions, so long as there is a prospect of amicable settlement by the existing machinery in the trade concerned. In the event of a breakdown or deadlock involving other bodies of workpeople or imperilling standard wages, hours or conditions, the General Council may take the initiative in calling representatives of the unions into consultation and using its influence to effect a just settlement. It is not correct that affiliation to the T.U.C. may involve the Association in obedience to instructions which the Congress may issue.

Reference is made to the National Federation of Professional Workers to which the Association is already affiliated. Some members of the E.P.E.A. have urged that rather than affiliate with the T.U.C. the Association should concentrate upon that body so as to constitute it a T.U.C. for the professional and non-manual workers. It is stated, however, that many staff unions are not members of the Federation and all but four of the unions in the Federation (of which the E.P.E.A. is the largest) are affiliated to the T.U.C.

Arguments For

The advocates of affiliation maintain that the Association does not exist solely to further the economic and financial interests of its members; technical staffs have a definite contribution to make to the welfare of their own industry, to other industries and the community in general.

Because it has "stood aloof," the E.P.E.A. has been unable to submit its views effectively on questions affecting all employed in industry such as unemployment, health insurance, compensation for accidents, hours of labour, education, industrial legislation and the general organisation of industry.

Those in favour of the move state that although it has been said that senior members of the Association would resign if affiliation were decided upon, many senior members are in favour of the proposal. To the argument that affiliation would embarrass senior members when representing employers in negotiations with manual workers it is replied that such a contention overlooks the fact that for the past twenty years the senior members of the E.P.E.A. have acted in their employers' interests in respect of many members of the junior grades and yet have been able to continue their membership without difficulty.

Opponents have contended that the National Joint Board could not continue to function in the event of affiliation and the Association's representatives would have to join the National Joint Industrial Council for the industry. The reply to this is that the Association, under Award 9281, has a legal right to suitable negotiating machinery and the Board's terms and conditions have been accepted as the "recognised terms and conditions" for the industry by the Industrial Court. It is unlikely that the Minister of Labour would permit the scrapping of this negotiating machinery.

The Opposing View

The arguments of those against affiliation are broadly that the proper place for all professional workers is in the National Federation. The E.P.E.A. has built up a prestige and commands a respect not excelled by any other professional trade union, without the aid of the T.U.C. Affiliation would weaken the Association.

While the T.U.C., it is agreed, is a body that commands admiration for the position it has gained it is not considered a suitable organisation for the E.P.E.A. The organisation of manual and professional workers in one body is detrimental to both; they should operate separately and co-operate when and where their interests lie together.

The danger of the dissolution of the National Joint Board must be seriously considered. If the Association were compelled to join the National Joint Industrial Council its problems could not receive full consideration.

It is not considered that affiliation would place the Association in a stronger position in negotiations with employers. The main force behind any claim is the strength and determination of the members themselves and to the extent to which they are prepared to make sacrifices in order to achieve their object.

Disagreement is registered with the argument that because the position of trade unions to-day is largely due to the T.U.C. all unions should be affiliated to that body. Reference is also made to the definite political connection between the T.U.C. and the Labour Party because of which many members of the E.P.E.A. would consider the termination of their membership if affiliation was decided upon.

Two-Wattmeter Balanced Power

A Simple Geometrical Method of Measuring Power Factor

By G. F. Freeman,
M.Sc., A.M.I.E.E.
(West Ham Municipal College)

IN the well-known two-wattmeter method of measuring three-phase power, two wattmeters W_R and W_B are connected as in fig. 1, with their current coils in the red and blue lines and their voltage coils connected across red-yellow and blue-yellow lines (in standard phase sequence, red-yellow-blue). If in addition the load is balanced and harmonics are absent, the vector relations are those of fig. 2; W_R measures $VI\cos(\varnothing+30$ deg.) and W_B measures $VI\cos(\varnothing-30$ deg.), where V and I are RMS line volts and amperes and $\varnothing$ the angle by which line current lags star voltage. Cos$\varnothing$ is the circuit power factor.

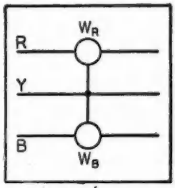


Fig. 1

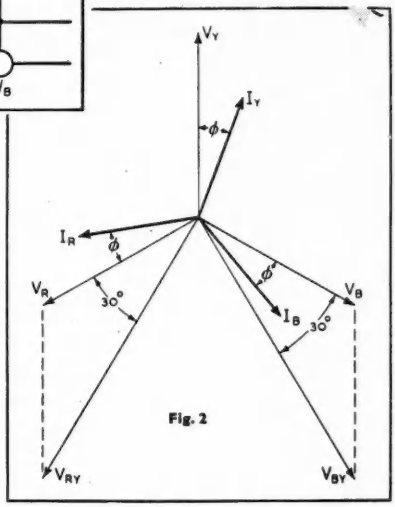


Fig. 2

Denoting the ratio W_R/W_B by R, it is customary to express the relation between R and cos$\varnothing$ in the form of a curve, providing a rapid and convenient check on power factor as alternatively obtained from the expression $(W_R + W_B)/(\sqrt{3}\ VI)$. The relation $\cos\varnothing = \frac{1}{2}\sqrt{\frac{(1+R)^3}{1+R^3}}$ may be deduced, but as a rule takes longer to use than the curve, which is therefore preferred.

It is, however, possible to obtain the power factor (and other related data) from the wattmeter readings by a purely geometrical method. In fig. 3, two equal circles are drawn, intersecting at O and P; the centre of each lies on the circumference of the other. A third circle, centre C_3 on the diameter OA is drawn to pass through O, the ratio of the radii OC_3/OC_1 being made equal to R. (If W_R is negative, the centre C_3' lies in AO produced.) The intersection R (or R′) is joined to O, and the line extended to meet the first circle in Q (or Q′). The angle QOP (or Q′OP) which this line makes with the

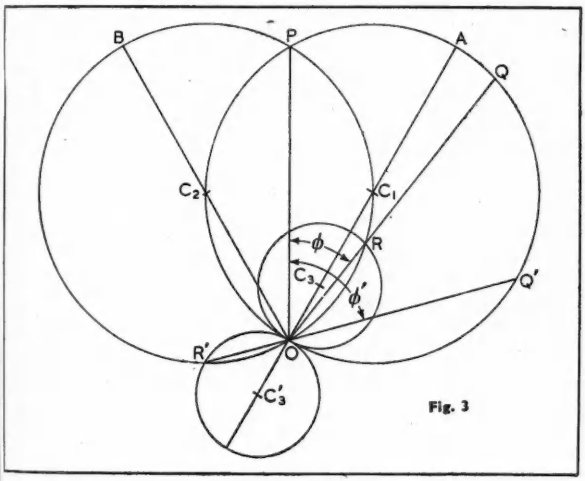


Fig. 3

common chord OP is then the phase angle ∅, drawn conventionally for lagging current.

The proof is very simple. Angles BOP, POA are each 30 deg. OR = OB cos (∅ + 30 deg.) and OQ = OA cos (∅ − 30 deg.). Since OA = OB, clearly OR/OQ = [cos (∅ + 30 deg.)/cos (∅ − 30 deg.)] = R. Having thus found ∅, cos ∅ may be derived by the usual quadrantal construction or other convenient method. Slight modifications facilitate this.

Thus in fig. 4, in which construction lines have been omitted, the relation between R and ∅ is expressed by radii drawn for selected values of R. A Cartesian net and the unit quadrantal arc (centre O) give cos∅ and its complement, sin∅, and further quadrantal arcs are added to furnish "current factors" which enable current to be deduced from one watt-meter reading and the voltage. Usually the larger reading is used for the sake of accuracy. [The relation is $I = W_B/KV = W_R/K'V$, where $K = OQ/OA = \cos(\varnothing - 30 \text{ deg.})$ and $K' = OR/OA = \cos(\varnothing + 30 \text{ deg.})$]. The portion of the second circle corresponding to negative values of R has been turned through 180 deg. to make the diagram more compact and to enable the positive K′ scale to be used, and the outer ring is marked to give phase angle in degrees.

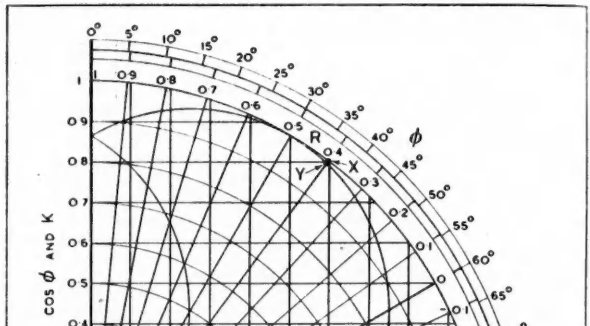


Fig. 4

To illustrate the use of the diagram, suppose wattmeter readings of 800 and 320 have been noted, the voltage being 200. R is 320/800. = 0.4, and the power is 800 + 320 = 1120 W. From fig. 4, cos∅ = 0.80, sin∅ = 0.60 (point X), K = 0.995 (point Y) and ∅ = 36.5 deg. The reactive voltamperes are thus 1120 × (0.6/0.8) = 840, and the current, 800/(200 × 0.995) = 4.02 amp. (or, from K′ = 0.40 at point Z, I = 320/(200 × 0.40) = 4.0 amp.). Had W_R been −320, points X′, Y′ (or Z′) would have been used, giving cos∅ = 0.24, sin∅ = 0.97, K = 0.695 (K′ = −0.28), ∅ = 76 deg., and 480 W, 1940 reactive voltamperes, 5.78 A obtained. The total voltamperes are (1120/0.8) = 1400 and (480/0.24) = 2000 in the two cases respectively.

It will be apparent that the two arcs of the second circle may be omitted if K is used throughout in preference to K′. Should the current lead the voltage, the red wattmeter will give the larger reading; in using the diagram, therefore, read W_R for W_B and vice versa; ∅ will now be the angle of *lead* instead of *lag*. Substitution of non-standard phase sequence will interchange lead and lag.

The limitations of load balance and wave purity mentioned at the outset should always be kept in mind when using this method of measuring power factor. It is nevertheless remarkable how small—two or three per cent. only—is the error commonly found when motor load having appreciable saturation harmonics and slight winding unbalance is in question. The check is also invaluable in calling attention to a false instrument constant, and since it can be so readily made is always worth while.

Institute of Fuel

A MEETING of the Institute of Fuel will be held in the Connaught Rooms, Kingsway, W.C.2, on October 15th, at 2.30 p.m., when Lt.-Col. Sir John Greenly, K.C.M.G., C.B.E., will install Mr. W. M. Selvey as president of the Institute for the coming year. Afterwards Mr. Selvey will give his presidential address, entitled "The Hundred Thousand : An Engineer's Philosophy." During the meeting the Melchett Medal for 1941 will be presented to Dr. Clarence A. Seyler, D.Sc., who will deliver the Melchett Lecture on "Recent Progress in Coal Petrology."

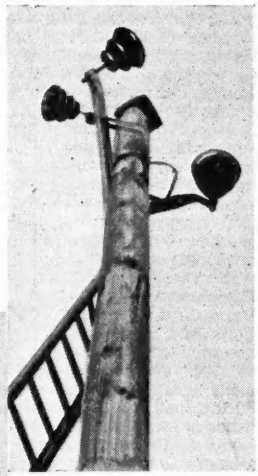
Frost and Ice

Their Effect on the Design of Overhead Lines

By
J. McCombe,
Ph.D., A.M.I.E.E.

OVERHEAD lines in this country were for many years regarded as being only mildly affected by the icing of conductors. This, however, has not been the case in other countries and reports appearing in the electrical Press from 1930 to 1938 suggest that this was a particularly bad cycle abroad. France had a crop of icing troubles during that period, in which 1933 seems to have been the peak year. Spain was also in much the same case, particularly in the Madrid area, while the "Niagara ice barrage" in 1938 put the Ontario power plant out of commission.

Within recent years this country also has experienced conditions which have been the worst in living memory. After severe icings in 1935 and 1937, which resulted in widespread fracturing of conductors, I investigated the problem of ice loading and the effect of span length and factor of safety on the stability of overhead lines under such deposits. For some reason which I have not been able to fathom, it is generally supposed that very high winds will prevent or restrict ice formations. The view is that in a normal wind the icing will not exceed three conductor diameters, in a high wind it will not exceed two, and in a gale it will be infinitesimal. If this were true the design of overhead lines to withstand such conditions would be simple. My experience, however, is entirely contrary to this hypothesis. Thus, in March, 1937, I experienced ice deposits in the presence of an extremely high wind which caused the failure of steel-cored aluminium conductors by overstress alone.



Figs. 1 & 2.—Above and left: A wood pole line for 33 kV, which collapsed due to ice loading

Fig. 3.—Conductor breakage showing the distinctive "necking" of strands characteristic of a tensile fracture

Windage in my opinion helps to build up ice deposits on the conductors. Each particle of ice or frost contains a certain amount of energy and this assists in the cohesion or agglomeration of the particles on the conductors. This, I believe, accounts for the different relative densities of varying ice deposits. In some cases the ice deposit will be almost solid while in other cases the majority of the annulus round the conductors is fuzzy. Where solid ice exists the relative density is of the order of 0.5 to 0.6 while the fuzzy variety is usually of 0.2 to 0.3.

Fig. 4.—Broken conductor showing burning, due to drawing of an arc on severance as well as necking

Another notable point is that ice coating is not proportional to the size of the conductor. Ice deposits always seem to be less on low-voltage than on high-voltage lines even in the same area and in some cases on the same poles. I am not attempting to prove that ice loading is proportional to line voltage and I am unable to give a reason for this, but I very much doubt whether electrostatic field or temperature has anything to do with this phenomenon.

In the Electricity Commissioners' Regulations for Overhead Lines (E1-C53, Revised) it is specified in Section 15 that "the factor of safety of line conductors shall be 2. The factor of safety shall be based on the breaking load, and shall be calculated on the assumption that the line conductors are at a temperature of 22 deg. F. and have a covering of ice to a radial thickness of three-eighths of an inch, and that they are simultaneously subjected to a wind of 50 miles per hour at right angles to the line, this wind to be taken as exerting a pressure equivalent to 8 lb. per sq. ft. calculated on the whole of the projected area of the ice covered lines." The Regulations do not take into account either altitude or span length. The former has often, and the latter always, an important bearing on line design.

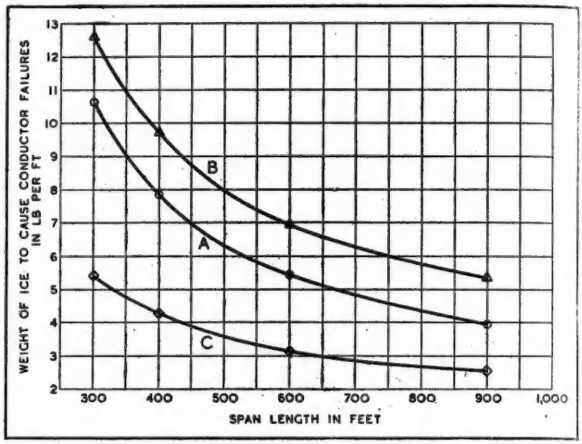


Fig. 5.—Relative strength of conductors A, B and C (see Table I)

TABLE I.—ICE LOADING TO CAUSE BREAKAGE WITH ⅜ IN. RADIAL ICE AT 22 DEG. F. AT VARYING SPAN LENGTHS.

Conductor	Factor of Safety	Span length ft.	Overall diameter of ice-loaded conductors to cause failure. In.	Weight of ice per ft. run to cause failure. lb.
A. Steel-cored aluminium 0.15 sq. in. equivalent (37/.102)	2	300	5.9	10.65
		400	5.08	7.88
		600	4.24	5.43
		900	3.64	3.97
B. Ditto	3	300	6.41	12.61
		400	5.60	9.71
		600	4.80	6.97
		900	4.21	5.36
C. Stranded copper 0.15 sq. in. (7/.166)	2	300	4.23	5.486
		400	3.75	4.276
		600	3.2	3.176
		900	2.9	2.556

Ice deposits on conductors can result in two types of faults. On falling off due to thawing or other causes they can initiate dancing conductors which often result in an earth fault or short-circuit. Alternatively, they may continue to build up until the conductors break due to mechanical overstress, causing supports to be pulled over and a general collapse of the line near the fracture.

It is a comparatively simple matter to calculate the ice loading to break any conductor if the characteristics of the conductor and the factor of safety and span length are known. In order to illustrate the method, the ice loading to break an 0.075 (7/.118) stranded copper conductor is calculated as follows:—Span length, 400 ft.; conductor diameter, d, 0.354 in.; conductor area, 0.075 sq. in.; conductor weight, 0.3 lb. per ft. run; modulus of elasticity, E, 18×10^6 lb. per sq. in.; radial thickness of ice, t, ⅜ in.; wind pressure per sq. ft. of projected area, 8 lb.; breaking load of conductor, 4,655 lb.; factor of safety, 2; maximum working load, $\frac{4,655}{2} = 2,327$ lb.

The weight of ice per ft. run at ⅜ in. radial $= 1.243t\,(t + d) = 1.243 \times 0.375\,(0.375 + 0.354) = 0.34$ lb. The total diameter of ice-loaded conductor $= 2 \times 0.375 + 0.354$ in. $= 1.104$ in. Wind pressure on ice-loaded conductor per ft. run $= \frac{2}{3} \times 1.104$ lb. $= 0.736$ lb. Therefore the total weight of ice loaded conductor per ft. run $= 0.30 + 0.34 = 0.64$ lb. and the resultant weight $= R = \sqrt{0.64^2 + 0.736^2} = 0.975$ lb.

Elongation of unit length of conductor due

Note: A constant value for modulus has been taken up to the failing of the conductor.

to maximum working tension of 2,327 lb. and loading $R = l_R = \frac{\text{maximum working tension}}{\text{area} \times \text{modulus}} = \frac{2,327}{0.075 \times 18 \times 10^6} = 0.001723$.

Tangential ratio, *i.e.*, tangential tension at support in unit span with unit loading R, $= T = \frac{\text{maximum working tension}}{R \times \text{span length}} = \frac{2327}{0.975 \times 400} = 5.97$.

Excess length ratio, *i.e.*, excess length of conductor per unit of span corresponding to

X	Horizontal tension	Sag	Tangential tension at supports, T	Excess length of wire in span, l
0.83	6.0241	$10^{-1} \times 0.20762$	6.0449	$10^{-2} \times 0.11486$
0.84	5.9524	$10^{-1} \times 0.21012$	5.9734	$10^{-2} \times 0.11764$

$T\,l = 0.0011764$. The excess length ratio l is given without any calculations, as it is much simpler to read it direct from tables. Many books give tables of catenarian functions and for overhead line sag-tension practice the tables given in "Sags and Tensions in Overhead Lines," by C. G. Watson, are invaluable. To illustrate the application of the tables an example is given. Any intermediate values can be interpolated.

Unloaded excess length of conductor in unit span $= l - e_R = 0.0011764 - 0.001723 = -0.0005466$, and elongation of unit length due to breaking load of 4,655 lb., $l_{R_1} = \frac{\text{breaking load}}{\text{area} \times \text{modulus of elasticity}} = \frac{4,655}{0.075 \times 18 \times 10^6} = 0.003446$.

Therefore excess length ratio at breaking load of 4,655 lb. $l_1 = [(l - e_{R_1}) + e_{R_1}] = -0.0005466 + 0.003446 = 0.0028944$.

Tangential ratio corresponding to l_1 (from tables), $T_1 = 3.8209$ and corresponding resultant force acting on unit length of conductor $f = \frac{\text{breaking load}}{\text{span length} \times \text{tan ratio } T_1} = \frac{4655}{400 \times 3.8209} = 3$ lb.

Therefore weight of ice per ft. run to cause conductor failure $= (f -$ conductor weight$) = (3 - 0.3) = 2.7$ lb. Weight of ice per ft. run $= 1.243t\ (t + d)$.

Therefore $1.243t\ (t + d) = 2.7 \therefore t^2 + 0.354t = \frac{2.7}{1.243} = 2.17 \therefore t = \frac{-0.354 + \sqrt{0.354^2 - (4 \times 1 \times -2.17)}}{2} = \frac{-0.354 + 2.96}{2} = 1.303$ radial inches of ice.

This is the radial thickness of the ice on the conductors to cause failure on a 400 ft. span. A similar calculation can be carried out for any span length.

The economic span length relative to ice loading on conductors although exceedingly important has received little consideration. In most cases conductors are selected for current carrying capacity, mechanical characteristics, and corona effects and the actual span lengths are governed by conductor sag and spacing. The conductors are erected at the minimum factor of safety without reference to location or span length, and in many instances special construction is resorted to only in the case of extremely long spans.

In the earlier days of overhead lines in this country the tendency was towards extreme caution and only short spans were run giving excellent service. With the rapid development of overhead lines the pendulum has swung right over and span lengths have been increased with a view to effecting economy by reducing the number of supports and insulators. Many engineers, however, are already regretting this change, because the economic span length is that which gives reasonable security under the worst conditions of loading experienced in that locality.

There are several methods of arriving at the economic span length and the following is one of them:—Determine the conductor size to meet the electrical requirements; determine the conductor type to meet the mechanical requirements relative to sag, tension, etc.; calculate the ice loading to break the conductor on various span lengths (usually for a factor of safety of 2 and on various span lengths to enable a curve to be plotted); plot a curve correlating span length with the weight of ice per ft. run to cause conductor failure; investigate the ice loading recorded locally.

From a consideration of the first four relative to the fifth the economic span for that conductor can be determined. Further graphs can be plotted for several types of conductors at varying factors of safety so that a span length to meet any required conditions can be easily selected. Different types of conductors require different ice loadings to cause fracture and in this connection composite conductors offer many advantages over plain conductors. The factor of safety is another important aspect as the higher it is at worst load conditions the greater the amount of ice loading to cause conductor failure.

The basic data from which the chart was plotted are given in Table I. These were calculated in the manner already described.

City & Guilds of London Institute

THE report of the City & Guilds of London Institute for 1940 states that candidates who sat for the Institute's examinations numbered 15,163 at home and 4,107 overseas, representing 50.4 and 102.2 per cent. respectively of the 1939 numbers. Failures were reduced to 30.2 and 47.6 per cent., respectively. Syllabuses for 1941-42 remained unaltered for all subjects except electrical installation work. Examination entries for 1941 totalled 18,800, including 4,925 at overseas centres. Both income and expenditure were reduced, the net result being a small surplus.

INSTITUTION PROCEEDINGS

Arrangements for I.E.E. Meetings

Benefits of Standardisation

IT would be disastrous if the end of the war were to find engineers unprepared to face the problems of peace in a changed world, said Mr. E. G. Taylor (General Electric Co., Ltd.), in his inaugural address as the new chairman of the Mersey and North Wales (Liverpool) Centre of the INSTITUTION OF ELECTRICAL ENGINEERS on October 6th. The value of co-ordination was foremost in the minds of all directorates responsible for increasing output. To enlarge production he considered rigid standardisation to be essential to the pooling of resources in the national interest.

Standardisation of electrical apparatus in this country, particularly in the heavier engineering sections, had lagged too far behind technical progress to maintain the industry in a healthy condition. The best example of total standardisation was the G.P.O. telephone all parts of which, even the smallest components, were interchangeable irrespective of the source of manufacture. The London Passenger Transport Board also had standard designs and dimensions for traction motors, which were completely interchangeable both mechanically and electrically. Only complete co-ordination of all parties concerned made such arrangements possible.

An American Example

International standardisation had recently been achieved in the rolling mill industry. In this case the American Association of Iron and Steel Electrical Engineers was instrumental in bringing into being in 1928 a complete range of standard ratings and frames at definite speeds for DC mill-type auxiliary motors, the principal dimensions of which were rigidly determined, including the fixing centres, overall lengths, centre heights, etc. In consequence, a standard machine was available in America for a specified duty, from more than one manufacturer.

Large rolling mill contracts for complete continuous mills were placed by this country with American manufacturers shortly before the war, part of the mechanical portion being made in the States, and the remainder produced in this country to American designs. The whole of the electrical equipment, however, was manufactured in England, and certain British electrical manufacturers agreed to adopt the American standards for mill-type motors and thus avoid any modifications to the mill housings.

To-day several firms had available a complete range of such standardised motors from 5 to 150 HP, which were mechanically interchangeable with the American machines. These combined American and British installations had given entire satisfaction in service.

Large users had realised the necessity for the standardisation of electrical apparatus in their various works, and within themselves had set up standardisation committees, but their activities had been considerably curtailed because such standards were available from one selected source of supply only.

In the present national emergency the importance of interchangeability of equipment immediately became apparent. Complete co-ordination in all respects for specific Government requirements, whether in research, design, production or the supply of material, had been achieved both in this country and in the United States. This had only been made possible by the willing response of all bodies to a national direction for the common end.

The Work of the B.S.I.

The production of a British Standard Specification invariably took three years or more, according to the amount of work involved. In spite of their being arrived at by general consent, with the present constitution, there was no compulsion on the community to use British Standards. In consequence, the freely given work and valuable experience of the Institution's expert members might become valueless. There lay the immediate and pressing problem: the demand for central or national direction in post-war planning.

In conjunction with various Government Departments, the B.S.I. had issued many War Emergency Specifications, the use of which had effected valuable national savings.

Complete uniformity of design might be the ultimate goal, but first efforts should be concentrated on the interchangeability of apparatus, and the fixing of dimensions to permit any commodity to be replaced by a similar alternative. Probably the best example of such an application was the electric lamp. The lamp cap was made to definite standard dimensions, and although the internal design and construction of the lamp were left to each manufacturer, interchangeability of the complete unit was thereby achieved.

Such a principle could be applied to nearly every domestic appliance, where the need for standardisation of plugs and sockets was obvious, whether it were a component part of

the apparatus, or the point at which it was plugged in. Extending this application to the heavier engineering commodities, the need for standard types of cable boxes for all duties was immediately apparent, and the mechanical dimensions of standard motors of specified types, duties and speeds, should be given consideration.

Transformer design having now settled down to a degree of uniformity, it would appear possible to standardise the external tank dimensions for a complete range up to, say, 1,000 kVA capacity at standard voltages to permit supply engineers to replace a transformer in the minimum time without breaking down the cable ends and to enable stocks to be reduced to the minimum. The standardisation of transformer accessories did not appear to present any great difficulty.

Interchangeability of sub-station switchgear would be extremely difficult to achieve, owing to the very many types still in demand. It would appear that some varieties existed simply for the sake of variety, and served no apparent useful purpose. A standard characteristic curve for inverse definite minimum time protective relays was badly needed, and the whole question of standardisation of line construction and types of line equipment appeared to require further investigation, while in post-war planning definite agreement must be reached and a simple standard tariff formulated which the domestic user could understand and appreciate.

These few examples at random enabled one to realise the immense possibilities which standardisation presented.

I.E.E. Programme

ORDINARY meetings of the INSTITUTION OF ELECTRICAL ENGINEERS and of its four technical sections are to be held in London monthly, in the afternoons. Informal meetings will not take place until next spring, when the longer hours of daylight may permit evening discussions. Copies of most of the papers to be presented will be obtainable in advance from the London office. In the event of cancellation of any meetings written contributions to the discussions will be accepted for publication in the *I.E.E. Journal*. The programme for the first half of the 1941-42 session is as follows:—

Ordinary meetings. Thursdays, 4 p.m.—
October 23rd—Sir Noel Ashbridge's presidential address.
November 20th—Mr. J. S. Forrest on the characteristics and performance in service of high-voltage porcelain insulators.
December 18th.—Messrs. W. G. Radley and E.P.G. Wright on voice-frequency signalling and dialling in long-distance telephony.
January 22nd.—Mr. L. B. Whitaker on a totally electrified cane sugar factory and Mr. B. Smith on electricity in a beet sugar factory.

Installations Section. Thursdays, 4 p.m.—
November 13th.—Mr. A. G. Ramsey to open informal discussion on solving wartime electrical problems.
December 11th.—Particulars to be announced later.
January 15th.—Mr. W. Gilchrist on some problems in the application of electric heating to residential and commercial premises.

Meter and Instrument Section. Fridays, 4 p.m.
November 7th.—Mr. W. Phillips, inaugural address as chairman.
December 5th.—Mr. D. J. Bolton on maximum demand metering; a study of the timing and length of the integration period.
January 2nd.—Messrs. R. S. J. Spilsbury and A. Felton on the electrostatic voltmeter as a DC/AC transfer instrument.
January 14th (3 p.m.).—Messrs. Casson and F. H. Birch on the measurement of protective gear on power supply systems (jointly with the Transmission Section).

Transmission Section. Wednesdays.—
November 12th (4 p.m.).—Mr. S. W. Melsom, inaugural address as chairman.
December 10th (3 p.m.).—Messrs. F. R. Perry, G. H. Webster and P. W. Baguley on the measurement of lightning voltages and currents in Nigeria.

Wireless Section, Wednesdays, 4 p.m.—
November 5th.—Mr. H. Bishop, inaugural address as chairman.
November 25th (Tuesday).—Informal meeting.
December 3rd.—Mr. E. Colin Cherry on the transmission characteristics of asymmetric sideband communication networks.
January 7th.—Mr. N. Wells on aerial characteristics.
January 27th (Tuesday).—Informal meeting.

Students' Sections

A MEETING of the Bristol Students' Section of the I.E.E. takes place at the Bath Corporation Electricity Department Showrooms, Old Bridge, Bath, at 7.15 p.m. to-day (Friday), when an informal discussion is being held on "Post-war Reconstruction and Re-organisation." Tea will be served at the Red House, New Bond Street, at 6.45 p.m. A meeting of the Section will be held at the Merchant Venturers' Technical College, Bristol, on October 17th, when an informal discussion will take place on the subject of "Electricity Troubles in Wartime." Tea will be served at the College at 6.45 p.m.

"Telecommunications of the Future" was the subject of a lecture delivered by Dr. W. G. Radley at Birmingham on October 8th to the South-Midland Students' Section. The speaker outlined recent developments and indicated probable future advances, stressing the need for co-operation.

COMMERCE and INDUSTRY

Utilities' Coal Stocks. New Board of Trade Division.

Coal Supplies

THE coal situation was discussed in the House of Lords last week when Lord Templemore, for the Government, said that it had been decided not to recall miners from the armed forces until every effort had been made to secure their return from other industries. About 21,800 returned men had been put to work and further steps were being taken to maintain and improve output.

As regarded public utilities, the stocks of electricity undertakings were now only slightly below the exceptionally high figure of a year ago and reserves were distributed fairly evenly throughout the country. The position of the gas industry was less satisfactory; the present inadequate stocks at a number of individual works was a matter for serious consideration, but efforts to place the industry in a reasonably secure position before the winter, were progressing favourably. The position with regard to essential industries was satisfactory, but there was a possibility of a shortage of house coal in the winter. Consumers were therefore being asked to exercise the strictest economy.

Electricity and Gas Control

As has been announced, an Order-in-Council was signed on September 11th transferring to the Board of Trade the functions in relation to electricity previously exercised by the Minister of War Transport. At the same time the Board has had under review the reorganisation required for the exercise of its functions in relation to the gas industry. It has now been decided to set up a new Division in the Industries and Manufactures Department (to be known as I. & M. Div. III) to carry out the Board's functions in relation to both industries. Sir Arthur Eborall will be Principal Assistant Secretary of the Division and Mr. A. J. Cousin, Assistant Secretary.

A Directorate of Gas Supply will deal with immediate questions relative to the public supply of gas to nationally essential factories, and advise steps to be taken to secure the progressive development of the industry as a public service. Dr. E. W. Smith, C.B.E. (released by the Woodall-Duckham Companies) will be Director-General of Gas Supply, and will have the assistance of Mr. J. F. Ronca, Mr. G. Evetts and Mr. P. Chantler.

Patent Extension Application

Application has been made for the extension of the period of Patent No. 278764 of 1926 in respect of "improvements in or relating to electric circuit-breakers" granted to Mr. W. B. Whitney, Mr. E. B. Wedmore and the British Electrical and Allied Industries Research Association. The matter will be heard in the High Court on November 11th and objections have to be lodged before that date.

Import Restrictions

Vacuum cleaners, ice cream freezers, hair dryers and curlers and all other domestic electrical goods except toasters, boiling rings, irons, fans and refrigerators are among items the import of which has now been prohibited in Barbados. Except in the case of goods produced or manufactured in any part of the British Commonwealth of Nations except Canada and Newfoundland, permits are now required for the import into the Union of South Africa and South West Africa of electric vacuum cleaners and floor polishers and radio-gramophones.

South American Representation

In the House of Commons last week Sir Andrew Duncan rejected a proposal that commercial agents should be appointed for Latin America in capacities similar to those of Sir Kenneth Lee and Mr. H. S. McIntosh in New York. When he was asked whether it was not very advisable to strengthen our exports, particularly to South America, Sir Andrew said that there were many considerations which had to be taken into account. For the present it would be unwise to adopt the suggestion.

Cadmium-Plating Dangers

Warning is given in *Science* against the use of cadmium for plating food utensils in consequence of the diversion of tin to war uses. It reports several outbreaks of acute poisoning owing to small amounts of cadmium in iced drinks and frozen fruit as a result of coating ice-cube trays and metal jugs with cadmium when reconditioning them.

In one case the refrigerant, sulphur dioxide, dissolved in the water to give sulphurous acid, which reacted with the cadmium to produce cadmium sulphite. In other cases the presence of cadmium was due to the action of acids in flavoured crystals for making fruit drinks or in gelatine powders for frozen dessert.

Electricity Supply Tables

A copy of the fifty-third edition (the first since May, 1939) of the *Electrician* Annual Tables of Electricity Undertakings for 1941-42, has been sent to us by the publishers, Benn Bros., Ltd. (12s. 6d. net). As usual the work contains details of the grid scheme—areas, tariffs, etc.; separate tables of British municipal and company undertakings; and details of the most important Dominion, Colonial and foreign undertakings. The difference between this issue and its predecessor is necessarily marked, particularly in the case of the table of foreign undertakings, from which entries covering areas of supply now in enemy occupation have been excluded. These revised tables, however, still retain their principal value.

Railway Directory

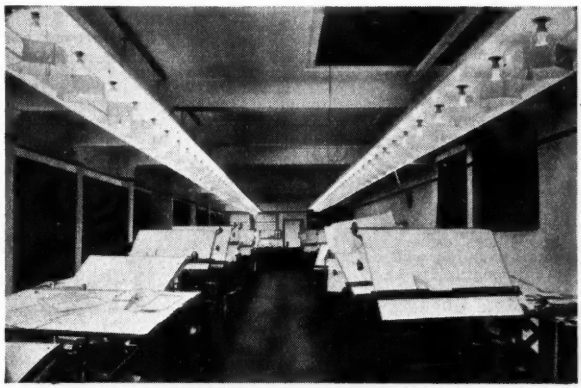
The 1940–41 "Universal Directory of Railway Officials and Railway Year Book," like its predecessors, is a very useful and comprehensive volume, in spite of the handicap of war conditions. Apart from details of the systems and personnel of railways in all parts of the world, occupying the first 390 pages, it contains 90 pages of statistical and other information. Among this may be mentioned a section upon the electrification of steam railways in Great Britain and overseas,

notes on electric traction and the classification of merchandise on British railways. The general index occupies 17 pages and a further 56 pages are devoted to a personal index of railway officials; the directory concludes with a buyers' guide. The publishers are the Directory Publishing Co., Ltd., 33, Tothill Street, London, S.W.1, and the price is 20s. net.

Office Lighting Installation

A new lighting installation in premises belonging to High Duty Alloys, Ltd., provides an excellent example of modern practice. The installation was designed by the Illuminating Engineering Department of the Metropolitan-Vickers Electrical Co., Ltd., which supplied the equipment. Careful attention has been paid not only to adequate illumination, but also to quality and the psychological effect on the workers; glare, contrasts of light and shadow, and excessive brightness have been avoided, and the general appearance attained is most pleasing.

The accompanying illustration shows a section of a drawing office in which the lighting is obtained from a special form of continuous troughing. This equipment consists essentially of a shallow canopy illuminated by means of 150-W "Cosmos" gasfilled lamps; these are mounted on the underside of the trough and spaced 2 ft. 6 in. apart. Caps are fitted beneath the lamps so as to avoid direct and reflected glare and to redirect light on to the inner surface of the canopy; hexagonal shields round the lamps are also provided. Hence, the source of light is virtually a large white surface of low brightness. The resultant illumination on the boards is equivalent to indirect lighting, being shadowless, glare-free and uniform. With a mounting height of 9 ft. 6 in. and troughs 10 ft. apart, a service illumination of 25 ft.-candles is obtained. The lighting of this office, 100 ft. long by 20 ft. wide, is obtained with a load of 10.8 kW.



A special form of continuous troughing used with 150-W "Cosmos" gas-filled lamps for the illumination of a drawing office

In a small office, 250 ft. by 20 ft., used for comptometer work the illumination is supplied by "Metrovick" 80-W mercury vapour fluorescent tubes, each 5 ft. long. Where conditions are suitable, these may with advantage be directly mounted on the ceiling. In this way the cost of fittings can be avoided and at the same time an economy in materials effected.

In order to develop this type of lighting Metropolitan-Vickers have produced a new type of control unit which enables fluorescent tubes to be mounted in continuous lines. The method was adopted in this case, and the general appearance is a definite improvement on the "forest" of separate points which are otherwise necessary. The continuous lines of tubes are mounted 10 ft. 6 in. high and 11 ft. apart to produce a service illumination of 14 ft.-candles. Eighty-three tubes have been used and the load is 7½ kW. In both offices the walls have been painted cream and the ceilings white, so that the general illumination is helped considerably.

Air-Raid Shelter Fatality

At an inquest held recently at Rotherham on a 15-year-old boy, John H. Smout, who received a fatal electric shock in an air-raid shelter at his home, the father, Mr. G. Smout, said he wired the shelter, but did not have it examined, not thinking it necessary. On the day before the accident he had switched the light on from the sitting-room of the house, and found that one of the lights did not work, owing to a loose connection, which could be made all right by using a match. There had been no trouble, until recently, with the wiring, which he fitted up last winter.

The boy's younger brother said that John put a piece of paper to the radiator to get a light. He screamed and fell to the ground. The electric light was burning, but the radiator had not come on.

An official of the Rotherham Corporation Electricity Department said that in his opinion the loose fitting of the adaptor needed adjustment by hand, and it would be possible for the radiator element to be alive but not alight. He thought the boy must have touched the live adaptor to make a proper contact. The shock would make him close his hand and grip the element of the radiator, thus receiving a further shock.

Mr. T. Redmayne, deputy electrical engineer, stated that it was not advisable to use flexible cable for carrying electricity to an air-raid shelter. A verdict of "Accidental death" was recorded.

Testing Aluminium Alloys

The need for the standardisation of methods employed in fatigue-testing aluminium alloys and in testing their mechanical strength at elevated temperatures has been recently urged by Mr. H. F. James of the Northern Aluminium

Co., Ltd. The majority of fatigue tests, he points out, do not closely simulate service conditions, in which stresses are too complex to be reproduced artificially. Also, the test results are greatly influenced by shape, size, surface finish and physical conditions, and there is no basis from which to work in any particular job. Thus, heat-treated duralumin will give consistent results under each set of stressing and straining actions, but will show appreciable variation in results from one set of conditions to another.

While testing at elevated temperatures does not involve the same inherent difficulties, the test data used should be such as to obviate any factors due to differences in procedure. The simplest way to do this is to standardise size, shape and finish of test pieces, temperatures of testing, time of soaking and rate of straining, the conditions approximating as closely as possible to those encountered in service.

Lack of standardisation and failure to state the conditions of testing when publishing the results of tests has led to the making of valueless comparisons of the various light alloys available for use at elevated temperatures. Until the necessary measure of standardisation has been introduced, designers should, when choosing material, take close account of the conditions of testing particularly with regard to time of soaking and straining.

Additions to "Black List"

The Board of Trade has made a new Order, the Trading with the Enemy (Specified Persons) (Amendment) (No. 16) Order, 1941 (Statutory Rules and Orders, 1941, No. 1466), containing 310 additions to the "Black List" of traders in neutral countries with whom it is unlawful to have dealings of any kind.

Changes of Name

Electrical Research Developments, Ltd., have changed their name to the E.R.D. Engineering Co., Ltd., while C. E. E. Co., Ltd., will in future be known as the Colton Electrical Equipment Co., Ltd.

Electrical Manufacture in India

According to *Indian Engineering*, the Mysore Board of Industries contemplates the manufacture of electric motors, starters, switchboards, etc.

Beryllium Copper

The properties of beryllium-copper which combines exceptional tensile and fatigue strengths with hardness, electrical conductivity and resistance to wear and corrosion have established its great usefulness for heavy duty springs, current carrying parts of electrical equipment, instrument diaphragms and a variety of other components of precision equipment.

It is now announced by Mallory Metallurgical Products, Ltd. (an associate company of Johnson, Matthey & Co., Ltd.), 78 Hatton Garden, London, E.C.1, that they are manufacturing an improved ternary alloy of this type, developed from the original beryllium-copper by the addition of a small percentage of cobalt, this resulting in improved and more uniform physical properties. This alloy, known as "Mallory 73 Beryllium-Copper," is available as strip, wire and tube in the soft state for forming into springs, switch blades, contact clips, diaphragms, bellows and similar parts. After forming, a short precipitation hardening process develops maximum physical properties, a tensile strength up to 85 tons per sq. in., a proportional limit of 50 tons per sq. in. and a hardness of 360 to 400 Brinell.

New Catalogues and Lists

Consolidated Pneumatic Tool Co., Ltd., Fraserburgh, Aberdeenshire.—Illustrated fifty-page catalogue (No. 899) detailing a complete range of universal electric tools for metal and wood work.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—Priced wartime folder detailing "Cosmos" lamps of all kinds, including non-standard voltage types and discharge tubes.

Benjamin Electric, Ltd., Brantwood Works, Tottenham, London, N.17.—Illustrated leaflet stressing planned lighting.

James Gordon & Co., Ltd., Dalston Gardens, Stanmore, Middx.—Illustrated leaflet (H.33) technically describing Hagan moisture separators for drying and cleaning steam.

Siemens Electric Lamps & Supplies, Ltd., 38-39, Upper Thames Street, London, E.C.4.—Emergency price-list No. 975 covering types of Siemens electric lamps in general demand. Illustrated price list 976 (superseding FT. 966) dealing with fluorescent tube lamps, reflectors and accessories.

TRADE MARK APPLICATIONS

THE following applications have been made for British trade marks. Objections to any of them may be entered within a month of October 1st.

CANEX (design). No. 615,167, Class 9. Electric dry batteries, torch cases, wireless apparatus and components thereof, wire for electrical purposes, irons, switches, connectors, adaptors, etc. Also No. 615,168, Class 11. Electric lamp bulbs, decorative lamps, cycle lamps, dynamos for cycle lamps, etc. Canex Co., Ltd., 108, City Road, London, E.C.1.

VACOLITE and OTARIAN. Nos. 615,902 and 615,903, respectively, Class 10. Instruments, apparatus and parts thereof for aiding the deaf. Allen & Hanburys, Ltd., Plough Court, 37, Lombard Street, London, E.C.3.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the following :—

BENTOR screwdrivers.

ELECTRICITY SUPPLY

"Nesco" Rating Decision.

Bexhill.—GUARANTEED REVENUE AGREEMENTS.—Subject to any action considered necessary to reserve to the Council its general right under the terms of agreements by estate developers and others for guaranteed revenue in respect of electricity, gas and water mains extensions, it is recommended that the enforcement of payment shall be suspended for twelve months.

Birkenhead.—LOAN.—The Corporation Electricity Committee is seeking sanction to borrow £5,000 for mains and services. It has agreed to provide a supply to a housing estate at Little Sutton at a cost of £390 for plant and £1,800 for mains.

Bolton. — ELECTRICAL INSTALLATIONS. — The Town Council proposes to have electricity installed in houses at Wellington Street.

Bristol.—RESTORATION OF MODIFIED LIGHTING.—As similar lighting has been in use in other cities despite enemy air attack, and the absence of lighting in Bristol has not given immunity from severe raids, the A.R.P. Committee has recommended the restoration of modified lighting until March 31st next. During the suspension of the lighting a number of the fittings have been used for air-raid shelters and some have been destroyed by enemy action and other causes, and the cost of replacing these would be £7,000. Maintenance and the supply of electricity and gas are estimated to cost £13,000.

Canada.—CHEAPER COMMERCIAL LIGHTING.—The Ottawa Hydro-Electric Commission has decided to reduce the commercial lighting charges in the capital by 10 to 11 per cent. as from the meter readings taken on or after November 1st this year.

Croydon.—FACTORY SUPPLIES.—The Corporation Electricity Committee is to provide supply to factories at a cost of £827.

SUBSTATION PROTECTION.—Further protection is to be provided at substations at a cost of £1,000.

Desborough.—TRANSFORMER HOUSE.—The Urban District Council has approved plans for the erection of a transformer house.

Durham.—APPEAL AGAINST ASSESSMENT.—The assessment for rating purposes of the North Eastern Electric Supply Co., Ltd., which had been put at £524,062, was the subject of a series of appeals which came before Durham County Rating Appeals Committee at Durham last week. The respondents were the County Valuation Committees of Durham and Northumberland and others. It was intimated when the proceedings opened that they might extend to three days, but a few hours later a settlement was announced. The cumulo was agreed at £417,000, of which £227,000 is to be allocated to Durham County. An order was made to that effect, and the hearing was adjourned so that the allocation of the Durham quota between the different rating areas could be proceeded with and produced as the final order of the court. No application was made with respect to costs.

Mr. Craig Henderson, K.C., opening for the company, said that the appeals were against the decisions of Assessment Committees in Durham County. In the quinquennial valuation of the company's receipts and expenses for 1932, which came into operation in April, 1934, the cumulo was agreed at the sum of £298,000. The valuation was adjusted from time to time and on April 1st, 1939, the rateable value was £344,746. By that date negotiations were on foot between the parties for a new valuation in the cumulo. No agreement was arrived at and in the end the rating authorities lodged proposals on September 26th, 1939, and the appeal was against the decisions of the Assessment Committees on those proposals raising the valuation by 52 per cent. The country had been at war three weeks when the Assessment Committees' new proposals were lodged, and he submitted that war risks should be taken into account and also the considerable expenditure on A.R.P. He understood that those figures had been entirely ignored in the proposed valuation.

Year's Working at Douglas.

Mr. A. R. Craig Hall, valuer for the company and 21 other electricity undertakings, said he made a valuation of the company's undertaking on a profits basis for 1938. and arrived at a rateable value of £290,004.

Eccles.—APPLIANCE WIRING COSTS.—An application for an increase in the fixed schedule of prices paid for the installation of wiring for appliances hired out by the Department was recently considered by the Electricity Committee. The borough electrical engineer considered that an increase of from 15 to 25 per cent. was justified, and the Committee agreed to an advance of 25 per cent.

ELECTRICITY CHARGES.—No action is to be taken by the Committee to bring into operation the proposed increase of 5 per cent. in charges pending receipt of the observations of the Electricity Commissioners.

Enfield.—ELECTRIC SHELTER HEATING REQUEST.—The U.D.C. Emergency Committee is asking the Regional Commissioners to sanction the heating of shelters by electricity owing to the difficulty of fuelling and lighting stoves and the risk of damage and theft of the stoves.

TARIFF INCREASE.—The Highways Committee reports that the Northmet Power Co. has increased the charges for lighting bollards, signs, &c., by 12½ per cent.

Glasgow.—SCHOOL INSTALLATION.—The Education Committee has accepted the offer of the Electricity Department to carry out the electric lighting installation and provision of clocks and bells at St. Mary's (Maryhill) School for £210.

Hull.—NO INCREASE IN TARIFFS.—Mr. D. Bellamy, general manager, recently reported to the Electricity Committee on the position of his Department, and said it was not proposed at present to recommend any increase in tariffs. The Committee paid a warm tribute to the manager and staff for their commendable efforts.

Isle of Man.—DOUGLAS ENGINEER'S REPORT.—An analysis of costs per kWh sold given in the 1940–41 annual report of Mr. B. Kelly, borough electrical engineer and manager of Douglas, shows that the large increase in the cost of fuel was almost cancelled out by decreases in other

items. The price of coal delivered at the Pulrose station had risen to £2 4s. 4½d. per ton before the end of the year, representing an advance of 11s. 11d. during the period and of £1 1s. 0½d. (90 per cent.) since March, 1937.

On the per-kWh-sold basis the cost of fuel and cartage averaged 0.63d. compared with 0.48d. in the previous year. Against this, salaries and wages (generation) were a point lower at 0.12d., and expenditure on repairs and maintenance of plant and buildings, &c., decreased from 0.14d. to 0.10d. Distribution costs dropped from 0.13d. to 0.09d., rent, rates, &c., from 0.03d. to 0.02d. and management expenses from 0.12d. to 0.08d. The overall working cost per kWh sold was 1.04d. against 1.03d. last year, 1.09d. in 1938–39 and 1.06d. in the two preceding years, and including interest and loan repayment charges the total cost was 1.44d. (1.77d.). The average price obtained for private supply was 2.32d. (2.19d.) and for bulk supply 0.93d., subject to adjustment (against 0.81d.).

The total income of the Department was £95,717 and working expenses were £58,817, leaving a gross profit of £36,900. Annual payments to the loans fund amounting to £14,734 were suspended during the year, only £3,317 being paid. After deducting this and adding sundry other revenue there was a net surplus of £15,948 (compared with last year's loss of £5,068), which has been transferred to the reserve fund.

The quantity of electricity generated was 15.2 million kWh, an increase of nearly two million kWh (14.9 per cent.) on the previous year. Sales were 12.4 million kWh, of which 5.5 million kWh was supplied in bulk to the I.o.M. Electricity Board for distribution outside the Council's area. The number of consumers connected rose from 6,325 to 6,414 and the average revenue per consumer increased from £8 18s. 0d. to £10 7s. 3d. Sales per consumer (private supply) averaged 1,072 kWh (against 976 kWh) and per head of the population 275 kWh (247 kWh). Total connections, excluding bulk supply, increased from 20,741 kW to 21,890 kW. The load factor improved from 31.52 to 32.26 per cent.

Further satisfactory progress was made in the domestic field, and the number of appliances on hire at the end of the year was 3,084—the Corporation's hire services were continued at pre-war rentals. Although war conditions affected the sale, as well as the purchase, of electrical appliances, the turnover was greater than for many years past, while increasing use was made of the showrooms by consumers desiring information; this was largely due to the abnormal number of changes of tenancy.

Keighley.—SCHOOL INSTALLATIONS.—The Education Committee has decided to have schools at Laycock, Oldfield and Haworth wired for electricity.

North-East Coast.—SHIPYARD LIGHTING.—Experiments have been carried out with a system of lighting which will permit work to be carried on during the black-out in shipyards. Tests have been made in one of the yards.

North-West Midlands.—SPECIAL ORDER.—The Electricity Commissioners have submitted to the Board of Trade for confirmation a Special Order made by them on the application of the North-West Midlands Joint Electricity Authority. Objections to the Order must be made to the Board of Trade (Gas and Electricity Department) by October 25th.

Nuneaton.—PRICE INCREASE REFERRED BACK.—A proposal by the Electricity Committee that electricity charges should be advanced by 5 per cent. was referred back by the Town Council at a recent meeting. The town clerk read a letter from the Electricity Commissioners stating that in view of the Government's policy of stabilising costs they felt unable to concur in the proposed increase.

Ruthin.—CHANGE-OVER.—Application is being made by the Town Council for sanction to an expenditure of £800 for a transformer in connection with the change-over.

Salford.—SUBSTATIONS AND METERS.—Application is being made for sanction to borrow £6,000 for substations and meters.

Sutton Coldfield.—SUPPLEMENTARY SUPPLY TO STREETLY.—The Corporation Electricity Committee has obtained sanction to borrow £1,850 for a supplementary supply in the Streetly area.

Wallasey.—SHELTER LIGHTING.—The Town Council has decided to have electric light installed in all shelters.

TRANSPORT

Eire.—BAN ON GAS FOR TRANSPORT.—Our Dublin Correspondent reports that in view of the coal shortage the Government has made an Emergency Order banning town-gas-propelled vehicles, thus rendering useless the £35–£60 spent by lorry owners and private persons on the equipment of several hundreds of cars.

L.N.E.R.—ELECTRIFICATION TEST.—A trial trip of the first of the 70 electric locomotives to be constructed for the main line from Sheffield to Manchester was made last Friday on the Manchester-Altrincham section, on which the work of electrification has been completed. The locomotive drew a train of approximately 250 tons, and the test was stated to have proved highly satisfactory. A speed of 64 MPH was reached at one stage of the trip. The electrified line will be operated on the 1,500-V, DC system with overhead transmission. The locomotive has motors giving a total of 1,860 HP at the one-hour rating. Its tractive effort is 45,000 lb.

Northern Ireland.—TROLLEY-BUSES IN BELFAST.—A large number of trolley-buses are on order for Belfast Corporation, but delivery of these is, of course, dependent upon war exigencies. However, the roads are being prepared in some cases by the erection of overhead equipment and preparations are being made for lifting the tram tracks. The new work includes one of the approaches to Stormont Parliamentary Buildings.

Southern Railway.—NEW ELECTRIC LOCOMOTIVE.—Preliminary details are now available of a fast new electric locomotive which has just been built for operation on the company's system. It will be suitable for use either for passenger or freight traffic, but, naturally, during the war period it will be employed primarily for freight. Building of the locomotive was commenced before the war and as opportunities have occurred it has been completed. As soon as tests are completed further particulars will be released. Future developments will depend entirely on post-war conditions.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

A. C. Cossor, Ltd., report a trading profit for the year to March 31st of £157,730, an increase of £21,702 as compared with the preceding year. After providing for war damage contribution, staff pensions, and directors' fees, the net profit, subject to tax, is £145,419 (against £130,226). Income tax and N.D.C. absorb £50,718, tax reserve receives £30,000 and the ordinary dividend for the year is maintained at 15 per cent. less tax. The balance carried forward is £29,959, an increase of £8,076.

The Renold & Coventry Chain Co., Ltd., reports a net profit of £93,404 as compared with £99,330, after providing £103,000 as compared with £94,000 for taxation. The dividend is maintained at 10 per cent.

Cable & Wireless, Ltd., has declared an interim dividend of 1½ per cent., as last year.

Cable & Wireless (Holding), Ltd., announces the payment of the dividend on the 5½ per cent. preference stock for the half-year to June 30th.

Murex, Ltd., is again paying a final ordinary dividend of 10 per cent. and a bonus of 2½ per cent., making 20 per cent. for the year.

The St. Austell & District Electric Lighting & Power Co., Ltd., has declared an interim dividend of 4 per cent. (same).

The Cables Investment Trust, Ltd., is again paying a final dividend of 3 per cent., making 5 per cent. for the year.

The British Electric Resistance Co., Ltd., is again paying a dividend of 20 per cent. for the year.

The Salisbury Electric Light & Supply Co., Ltd., announces the payment of an interim dividend of 4 per cent. (as last year).

The River Plate Electrical & Other Securities Corporation, Ltd., is repeating its interim dividend of 2 per cent.

G. D. Peters & Co., Ltd., have declared an interim dividend of 7½ per cent., as last year.

Erinoid, Ltd., is to pay 10 per cent. on its ordinary capital, compared with 6 per cent. in the previous year.

John Thompson Engineering, Ltd., is maintaining its interim dividend at 5 per cent.

New Companies

Watford Storage Battery Co., Ltd.—Private company. Registered September 24th. Capital, £1,000. Objects: To carry on the business of manufacturers, fitters, maintainers and repairers of, and dealers in, batteries, dynamos, accumulators, motors, telephone bells, signals, fire and burglar alarms and other electrical apparatus and wireless and television goods, etc. Directors: E. Hickey and Mrs. A. Hickey, both of 89, Tudor Avenue, Watford, Herts. Secretary: E. Hickey. Registered office: Station Estate, Balmoral Road, Watford.

British Switchgear Corporation, Ltd.—Private company. Registered September 20th. Capital, £100. Objects: To acquire patents and machinery, to carry on the business of engineers and manufacturers of mechanical and electrical apparatus, etc. Directors: C. E. Peczenik and C. C. Bewsher, both of 3, Grosvenor Square, W.1; and G. C. Lovibond, 24, Hans Road, S.W.3. Secretary: J. Fraser. Registered office: 167, Great Portland Street, W.1.

Henston Engineering Co., Ltd.—Private company. Registered September 22nd. Capital, £100. Objects: To carry on the business of manufacturers of, and dealers in, fixtures, bakelite moulds and tools, mechanical, hydraulic, electrical, radio and general engineers, metal workers, etc. Permanent directors: E. Stone, 58, Osborne Road, Romford, and H. Salmon, 10, Ashwood Avenue, Rainham.

Brink & Thomas, Ltd.—Private company. Registered September 11th. Capital, £2,000. Objects: To acquire the business of bakelite mould makers carried on by Arie V. Brink, as "Brink & Thomas," and to carry on the business of mould and tool makers, metal workers, etc. Directors: Arie van den Brink, 1, Rose Walk, West Wickham, Kent, and two others. Registered office: 196, Morland Road, East Croydon, Surrey.

J. Cameron & Co., Ltd.—Private company. Registered September 23rd. Capital, £1,500. Objects: To acquire the business of an electrical engineer carried on by J. Cameron at Dawbridge Works, Hunslet Road, Leeds, and to carry on the business of electrical, mechanical and general engineers, etc. Directors: D. M. Dixon, The Laurels, Chidwell, Dewsbury, and Mrs. Alice Cameron, 230, Dewsbury Road, Leeds. Registered office: Canal Mills, Brandon Street, Armley Road, Leeds, 12.

Yardley Metals, Ltd.—Private company. Registered September 23rd. Capital, £100. Objects: To carry on the business of constructional, electrical, mechanical and general engineers, tool makers, metal workers and founders, etc. Subscribers, H. V. White and J. F. Welson, both of 326, Church Road, Yardley, Birmingham, and P. D. N. Castle, 5, Blythsford Road, Hall Green, Birmingham. Registered office: 1191, Stratford Road, Hall Green, Birmingham.

John Bamforth & Sons, Ltd.—Private company. Registered September 19th. Capital, £2,000. Objects: To carry on the business of refrigerating, air conditioning, heating, humidifying and ventilating engineers, electricians, etc. Directors: G. V. Singleton, 14, Dingle Road, Alkrington Park, Middleton, J. Bamforth, 35, Jubilee Road, Middleton, and H. Lakin, Sterndale, Ebberton Road, Rhos-on-Sea, N. Wales. Registered office: Hanson Street, Middleton.

Leigh-Kenwood Engineering Co., Ltd.—Private company. Registered September 30th. Capital, £3,000 in 3,000 shares of £1 each. Objects: To carry on the business of engineers, electricians, etc. Directors: J. A. Leigh, 16, Oman Avenue, Anson Road, N.W.2; R. Kenneth Taylor, 63,

Livingstone Road, Southall, Mdx.; and W. H. Inwood, 37A, Livingstone Road, Southall, Mdx. Registered office: 13, Fleet Street, London, E.C.4.

Companies' Returns

Statements of Capital

Babcock & Wilcox., Ltd.—Capital, £4,620,000 in 100,000 6 per cent. preference, 200,000 5 per cent. second preference and 4,320,000 ordinary shares, all of £1. Return dated June 12th. 100,000 6 per cent. preference, 179,056 5 per cent. second preference and 4,299,656 ordinary shares taken up. £1,029,884 paid on 179,056 5 per cent. second preference and 850,828 ordinary shares. £3,548,828 considered as paid on 100,000 6 per cent. preference and 3,448,828 ordinary shares. Mortgages and charges: Nil.

British Mica Co., Ltd.—Capital, £5,000 in 2,000 preference and 3,000 ordinary shares of £1 each. Return dated June 12th. 885 preference and 2,194 ordinary shares taken up. £1,079 paid on 885 preference and 194 ordinary shares. £2,000 considered as paid on 2,000 ordinary shares. Mortgages and charges: £2,300 debentures and £650 mortgage.

London Electric Wire Co. and Smiths, Ltd.—Capital, £1,250,000 in 500,000 preference and 750,000 ordinary shares of £1. Return dated June 11th. 400,000 preference and 684,070 ordinary shares taken up. £350,035 paid on. 350,000 preference and 35 ordinary shares £734,035 considered as paid on 50,000 preference and 684,035 ordinary shares. Mortgages and charges: Nil.

D.P. Battery Co., Ltd.— Capital, £100,000 in £1 shares. Return dated June 11th. All shares taken up. £28,000 paid. £72,000 considered as paid. Mortgages and charges: Nil.

Johnson & Tanner, Ltd.—Capital, £2,500 in 1,000 preference shares of £1 each and 30,000 ordinary shares of 1s. each. Return dated June 5th. 1,000 preference and 25,350 ordinary shares taken up. £1,267 10s. paid. £1,000 considered as paid. Mortgages and charges : £553.

Electrical Power Fitting Co., Ltd.—Capital, £500 in 500 shares of £1 each. Return dated June 7th. 305 shares taken up. £218 3s. 10d. paid. £86 16s. 2d. considered as paid. Mortgages and charges: Nil.

Meteor Electric Lamp Co., Ltd.—Capital, £500 in 500 shares of £1 each. Return dated June 10th. 100 shares taken up. £100 paid. Mortgages and charges: Nil.

Rutland Electric Lamp Co., Ltd.—Capital, £500 in 500 shares of £1 each. Return dated June 10th. 100 shares taken up. £100 paid. Mortgages and charges: Nil.

L. Weekes (Luton), Ltd.—Capital, £10,000 in £1 shares. Return dated June 11th. All shares taken up. £10,000 considered as paid. Mortgages and charges: Nil.

Liverpool Electric Cable Co., Ltd.—Capital, £300,000 in £1 shares. Return dated June 11th. 150,000 shares taken up. £127,833 paid. £22,167 considered as paid. Mortgages and charges: Nil.

W. Sisson & Co., Ltd.—Capital, £50,000 in 38,000 ordinary, 5,000 preference and 7,000 deferred shares of £1 each. Return dated June 24th. 4,375 preference, 31,711 ordinary and 7,000 deferred shares taken up. £28,686 paid. £14,400 considered as paid. Mortgages and charges: £8,000.

Kelvinator, Ltd.—Capital, £65,000 in 40,000 preference shares of £1 each and 500,000 ordinary shares of 1s. Return dated June 25th. All shares taken up. £65,000 paid. Mortgages and charges: Nil.

G. L. Adamson, Ltd.—Capital, £7,500 in 7,500 shares of £1 each. Return dated June 25th. 6,236 shares taken up. £1,736 paid. £4,500 considered as paid. Mortgages and charges: Nil.

J. S. Ramsbottom & Co., Ltd.—Capital, £10,000 in 10,000 shares of £1 each. Return dated June 25th. All shares taken up. £1,000 paid. £9,000 considered as paid. Mortgages and charges: Nil.

Mortgages and Charges

North Eastern Electric Supply Co., Ltd.—Satisfaction to the extent of £18,381 on August 12th, 1941, of trust deed dated October 31st, 1930, and registered November 8th, 1930, originally securing £2,300,000 5 per cent. consolidated debenture stock.

Carlisle Electrical Manufacturing Co., Ltd.—Debenture, charged on the company's undertaking and property, present and future, including uncalled capital, dated September 19th, to secure all moneys due or to become due from the company to Williams Deacon's Bank, Ltd.

Underwood (Electric) Ltd.—Assignment on September 17th of proceeds of certain contracts, to secure all moneys due or to become due from the company to Martins Bank, Ltd., not exceeding £18,000 at any time.

Ruths International Accumulators, Ltd.—Satisfaction in full on May 31st, 1941, of debentures authorised December 15th, 1938, and registered January 25th, 1939, securing £5,000. (Notice filed September 23rd.)

Receivers Appointed and Released

Amalgum Products, Ltd.—Wm. K. Fox, of Sterling Works, Dagenham, ceased to act as receiver on September 19th. Claude H. I. Chown, of 47a, Cranbrook Road, Ilford, was appointed receiver on September 19th, under powers contained in debenture dated April 7th, 1936.

Boleyn Electric Bakery, Ltd.—H. L. Ratcliffe, 171, Shaftesbury Avenue, W.C.2, ceased to act as receiver and manager on September 20th.

Liquidations

Musgrave Radio, Ltd.—Winding-up voluntarily. Liquidator, Mr. A. G. Brayshaw, 28, Grantham Avenue, West Hartlepool.

Synchronous Telegraphs, Ltd.—Meeting October 31st at 94, Old Broad Street, London, E.C.2, to receive an account of the winding-up by the liquidator, Mr. F. J. B. Gardner.

Dulci Electrical Co., Ltd.—Last day for receipt of proofs for dividend October 21st. Liquidator, Mr. L. R. Binns, 4, Broad Street Place, London, E.C.2.

Bankruptcies

G. A. Weston, 5–6, Roman Wall House, Crutched Friars, London, E.C.3, electrical contractor and engineer.—Receiving order made September 20th.

STOCKS AND SHARES

TUESDAY EVENING.

NO thought of changing its cheap money programme has entered the mind of the Government, according to the Chancellor of the Exchequer, who seems never to tire of reiterating statements of policy that the nation now accepts as a matter of course. The manner in which Stock Exchange prices stand up to the financial conditions imposed by the war is ample witness to the composure of investment. Rumours of an early issue of another national loan are in the air; they exert no unfavourable effect upon the prices of existing securities. Speculation has been taking an active interest in oil shares, shipping and South African mining ventures. The urge to buy ordinary shares in front-rank industrial companies remains as strong as ever.

Price Fluctuations

British Power & Light shares at 26s. have put on 1s. Electric Finance & Securities are $\frac{1}{16}$ harder at 43s. 9d.; Electric Supply Corporation rose to 43s. 9d. There is still considerable demand for ordinary shares in the provincial electricity companies. Llanellys at 21s. 6d. are 6d. harder. Debenture stocks and preference shares continue in request. The 3½ per cent. debenture stocks of Central London Electricity and the Midland Electric Power Co. have risen to 91 and 87½ respectively. North Eastern fives at 102½ and Shropshire fives at 110 are both a point to the good.

Investment readily takes the Indian shares which come to the market. Calcutta Electric, Cawnpore and Madras Electric Supply shares are better on the week. Victoria Falls ordinary, which went back a trifle, have recovered to 78s. 9d. Perak Hydro-Electrics at 19s. 6d. are 9d. higher owing to the firmness of the market for tin.

Investment Famine

Stock Exchange business is decidedly better to-day than it was twelve months ago. Investment and speculation are both playing an active part. Despite the handicap imposed upon freedom of dealing by the cash system under which Stock Exchange transactions are now controlled, there is a noticeable extension of trade in most markets. This would be still greater were it not for the pronounced scarcity of stock. Rises of 2s. 6d. in Callender's, of 1s. 3d. in British Insulated and in Enfield Cables, of 6d. in Telephone and General Trust (to 24s. 3d.) and British Aluminium testify to the constant pressure to buy.

Equipment and Manufacturing

Speculation in Electric and Musical Industries shares has been active during the past few days, the price rising 1s. to 13s. 3d. Market anticipation looks for declaration of a dividend next month. Last year, the company paid nothing on its ordinary shares, against 5 per cent. in the previous year. The shares are of 10s. each, and from the present quotation it would appear as though a dividend of 10 per cent. is looked for. The recent cut in the British Vacuum Cleaner dividend from 12½ per cent. to 10 per cent. has made no difference to the firmness of the price, which shows $\frac{1}{16}$ rise at 12s. 6d. Johnson & Phillips are better at 53s. 3d. London Electric Wire rose to 25s. on announcement of a dividend making 7½ per cent. for the year, the same as before. Lucas shares are a shade easier at 60s. Switchgear & Cowans at 10s. show a nominal rise of $\frac{1}{16}$, but this alteration should have been made some time ago, the official price of 8s. 9d. being evidently an oversight. Lancashire Dynamos at 62s. 6d. continue their advance. Inquiry for low-priced shares has spread to Brush ordinary around 4s. 6d., and a fair number of transactions are taking place. Vactrics are 3d. up, at 3s. 3d.

Globe Telegraph & Trust

Globe Telegraph & Trust ordinary shares are $\frac{1}{16}$ better at 30s. and the preference at 28s. 9d. The company has declared, in somewhat ambiguous language, a quarterly dividend of 1½ per cent. less tax on the preference shares, plus ½ per cent. in respect of the thirteen months ended June 30th, 1941. The wording of the announcement made it appear as though the 6 per cent. preference stock was to receive an extra 10s. per cent. Actually, the company is about to distribute an additional one month's dividend, *i.e.* 10s. per cent., in order to compensate for the year ending a month later than it did previously.

Cable and Wireless Dividends

It may be recalled that the date of the Cable and Wireless preference dividend was twice put forward. Instead of its being paid, as previously, on September 30th, the present date of payment is November 15th, though so far, in spite of protests made here and elsewhere, nothing more than six months' dividend, instead of one dividend for six months-plus-six-weeks, has been paid at the new dates. The lead set by the Globe Telegraph & Trust in declaring an extra dividend in respect of a year of thirteen months might be followed, justifiably and equitably, by Cable and Wireless when its next dividend payment falls due. The preference stock at 104 and the ordinary at 64, are better by 1 and 2 points respectively.

Good Mixers

In the continual search which goes on week by week and day by day for investment securities, the claims of at any rate two stocks appear to be overlooked. Anglo-American Telegraph 6 per cent. preferred at 107½ gives a yield of £5 11s. 9d., and the dividend is well

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ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend 1939–40	Dividend 1940–41	Middle Price Oct. 7	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole	15	12½	52/6	..	4 15 5
British Power and Light	7	6	26/–	+1/–	4 12 4
City of London	7½	7	25/9	..	5 8 9
Clyde Valley	8	8	37/6	..	4 5 4
County of London	10½	8	35/9	..	4 9 5
Edmundson's:					
7% Pref.	7	7	32/6	..	4 6 2
Ord.	6	6	28/–	+6d.	4 5 9
Elec. Dis. Yorkshire	9	9	40/9	..	4 8 3
Elec. Fin. and Securities	12½	12½	43/9	+⅛	5 14 2
Elec. Supply Corporation	11½	10	43/9	+⅛	4 11 4
Isle of Thanet	2	Nil	9/–	..	—
Lancs Light and Power	7½	7½	33/9	..	4 9 0
Llanelly Elec.	5½	5½	21/6	+6d.	5 2 4
Lond. Assoc. Electric	5½	4½	19/6	..	4 12 4
London Electric	7	7	24/6	..	5 14 3
London Power Deb. Red.	5	5	103	..	4 17 2
Metropolitan	10	8	36/3	..	4 8 5
Midland Counties	8	8	38/3	..	4 3 4
Mid. Elec. Power	9	9	38/3	+⅛	4 13 0
Newcastle Elec.	7	7	27/6	..	5 1 10
North Eastern Elec.:					
Ordinary	7	7	29/6	..	4 15 0
7% Pref.	7	7	32/6	..	4 6 2
Northampton	10	10	44/6	..	4 10 0
Notting Hill 6% Pref. (£10)	6	6	8½	..	—
Northmet Power:					
Ordinary	10	7	35/–	..	4 0 0
6% Pref.	6	6	29/6	..	4 1 4
Richmond Elec.	6	6	22/6	..	5 6 8
Scottish Power	8	8	38/3	..	4 3 4
Southern Areas	5	5	17/6	..	5 14 3
South London	7	7	23/6	..	5 19 2
West Devon	5	5	21/3	..	4 14 1
West Glos.	4½	4½	19/6	..	4 12 4
Yorkshire Elec.	8	8	39/6	..	4 1 0
Overseas Electricity Companies					
Atlas Elec.	Nil	Nil	3/–	−3d.	—
Calcutta Elec.	8*	7*	37/6	+6d.	3 14 9
Cawnpore Elec.	10	10	28/9	+6d.	6 19 0
East African Power	7	7	25/9	..	5 8 9
Jerusalem Elec.	7	5	18/9	..	5 6 8
Kalgoorlie (10/–)	7½	7½	13/–	−6d.	5 15 5
Madras Elec.	6*	4*	22/6	+⅛	3 11 1
Montreal Power	1½	1½	26½	..	5 13 2
Palestine Elec. "A"	Nil	Nil	17/6	−⅛	—
Perak Hydro-elec.	2½	6	19/6	+9d.	6 3 0
Shawinigan Power	83cts.	90cts.	16½	..	—
Tokyo Elec. 6%	6	6	36½	..	16 8 8
Victoria Falls Power	15	15	78/9	+⅛	3 16 2
Whitehall Inv. Pref.	7½	7½	14/6	..	10 6 10

Company	Dividend 1939–40	Dividend 1940–41	Middle Price Oct. 7	Rise or Fall	Yield p.c. £ s. d.
Public Boards					
Central Electricity:					
1950–70	5	5	110	..	4 11 1
1955–75	5	5	113	..	4 8 6
1951–73	4½	4½	107	..	4 4 1
1963–93	3½	3½	101	..	3 9 4
1974–94	3½	3½	94xd	+1	3 9 2
London Elec. Trans. Ltd.	2½	2½	95	..	2 12 8
London & Home Counties 1955–75	4½	4½	106½	..	4 4 6
Lond. Pass. Trans.:					
A	4½	4½	113½	..	3 19 4
B	5	5	113½	..	4 8 1
C	1½	3	42	−1	7 2 10
West Midlands J.E.A. 1948–68	5	5	108½	..	4 12 0
Telegraph and Telephone					
Anglo-Am. Tel.:					
Pref.	6	6	107½	..	5 11 9
Def.	1½	1½	24½	..	6 2 5
Anglo-Portuguese	8	8	15/–	..	10 13 4
Cable & Wireless:					
5½% Pref.	5½	5½	104	+1	5 5 10
Ord.	4	4	64	+2	6 5 0
Canadian Marconi $1	Nil	4cts.	6/–	..	3 6 0
Globe Tel. & Tel.:					
Ord.	8*	8½*	30/–	+⅛	—
Pref.	6	6	28/9	+⅛	4 3 6
Great Northern Tel. (£10)	20	20	14½	..	—
Inter. Tel. & Tel.	Nil	Nil	3	..	—
Marconi-Marine	7½	7½	26/3	..	5 14 1
Oriental Tel. Ord.	11½*	16	7½xd	..	4 9 10
Telephone Props.	6	6	11/3	..	10 13 4
Tele. Rentals (5/–)	10	10	9/–	..	5 11 3
Traction and Transport					
Anglo. Arg. Trams:					
First Pref. (£5)	Nil	Nil	2/6	+6d.	—
4% Inc.	Nil	Nil	7½	..	—
Brit. Elec. Traction:					
Def. Ord.	45	45	885	..	5 1 8
Pref. Ord.	8	8	170	..	4 14 2
Bristol Trams	8*	8	41/3	..	3 17 8
Brazil Traction	$1	50c.	11½	+1	—
Calcutta Trams	8	5½	23/9	..	4 12 7
Cape Elec. Trams.	5	5	19/–	..	5 5 3
Lancs Transport	10	10	42/6	..	4 14 1
Mexican Light:					
1st Bonds	5	5	55	..	—
Rio 5% Bonds	5	5	92½xd	+4	5 8 1
Southern Rly.:					
5% Prefd.	5	5	62½	..	8 0 0
5% Pref.	5	5	98½	..	5 1 7
T. Tilling	10	10	46/3	..	4 6 7
Tilling & B.A.	8*	7*	52/6	..	2 13 1
West Riding	10	10	39/–	..	5 2 7

(*Continued on nert page*)

* Dividends are paid free of Income Tax.

Company	Dividend 1939–40	Dividend 1940–41	Middle Price Oct. 7	Rise or Fall	Yield p.c.
Equipment and Manufacturing					£ s. d.
Aron Elec. Ord. ..	Nil	7½	22/–	..	6 16 4
Assoc. Elec.:					
Ord.	10	10	43/9	..	4 16 3
Pref.	8	8	36/3	..	4 8 5
Automatic Tel.& El.	12½	12½	46/3	..	5 8 3
Babcock & Wilcox	11	11	45/–	..	4 17 9
British Aluminium	12½	10	45/–	+6d.	4 9 0
British Insul. Ord...	20	20	91/3	+⅛	4 7 9
British Thermostat (5/-)	18½	18½	13/9	..	6 14 6
British Vac. Cleaner (5/-)	12½	10	12/6	+⅛	4 0 0
Brush Ord... ..	Nil	Nil	4/6	+6d.	—
Callender's ..	15	15	72/6	+½	4 2 9
Chloride Elec. Storage	15	15	67/6	..	4 9 0
Consolidated Signal	17	17	75/–	..	4 10 10
Crabtree (10/-) ..	17½	17½	28/9	..	6 1 9
Crompton Parkinson Ord. (5/-) ..	30	20	19/6	..	5 2 8
E. K. Cole (5/-) ..	10	Nil	7/–	+3d.	—
E.M.I. (10/-) ..	5	Nil	13/3	+1/–	—
Electric Construction	10½	10	32/6	..	6 3 0
Enfield Cable Ord.	16½	12½	52/6	+⅛	4 15 3
Elecl. Switchgear (10/-)	16	10	20/–	..	5 0 0
English Electric ..	10	10	36/3	+⅛	5 10 4
Ensign Lamps (5/-)	25	25	16/3	..	7 13 10
Ericsson Tel. (5/-) ..	25*	22*	40/–	..	2 13 4
Ever Ready (5/-) ..	40	40	28/6	..	7 0 4
Falk Stadelmann ..	7	7½	17/6	..	8 11 6
Ferranti Pref. ..	7	7	26/3	..	5 6 10
G.E.C.:					
Pref.	6½	6½	32/6	..	4 0 0
Ord.	20	17½	77/6	..	4 10 2
Greenwood & Batley	15	13	22/6	..	11 11 2
Hall Telephone (10/-)	15	10	15/–	..	6 13 4
Henley's (5/-) ..	20	20	21/3	..	4 14 1
4½% Pref. ..	4½	4½	21/3	..	4 4 8
Hopkinsons ..	15	15	45/9	..	6 11 0
India-Rubber Pref.	5½	5½	21/3	..	5 3 6
Intl. Combustion ..	32½	30	105/–	..	5 14 3
J. Lucas	15	15	60/–	–⅛	5 0 0
Johnson & Phillips	15	15	53/3	+9d.	5 12 9
Lancashire Dynamo	20	20	62/6	+⅛	6 8 0
Laurence, Scott (5/-)	15	15	10/9	..	6 19 6
London Elec. Wire	7½	7½	25/–	+½	6 0 0
Mather & Platt ..	13½	10	42/6	..	4 14 1
Metropolitan Elec. Cable Pref. ..	5½	5½	21/3	..	5 3 6
Murex	20	20	87/6	..	4 11 4
Pye Deferred (5/-)..	25	25	13/9	..	9 1 10
Revo (10/-) ..	5	20	23/9	..	8 8 5
Reyrolle	12½	12½	55/–	..	4 10 3
Siemens Ord. ..	7½	7½	23/9	..	6 6 4
Strand Elec. (5/-) ..	4	2	3/–	..	3 6 8
S. Smith (4/-) ..	37½	50	7/–	..	7 2 10
Switchgear & Cowans (5/-)	10	15	10/–	+⅛	7 10 0
Tel. Condenser (10/-)	Nil	5	11/3	..	4 9 0
T.C. & M.	10	10	41/3	..	4 17 0
Telephone Mfg. (5/-)	9	9	8/3	..	5 9 1
Tube Investments..	23½	23¾	92/6	..	5 2 8
Vactric (5/–) ..	4	Nil	3/3	+3d.	—
Vickers (10/– ..	10	10	17/–xd	..	5 17 8
Ward & Goldstone (5/-)	20	20	16/6	..	5 19 9
Westinghouse Brake	17½	10	47/6	..	4 4 4
Walsall Conduits (4/-)	55	55	31/3	..	7 0 9
West, Allen (5/-) ..	7½	7½	5/–	..	7 10 0

* Dividends are paid free of Income Tax.

Stocks and Shares (*Concluded from page* 383)

secured. The Anglo-American Company is controlled by the Western Union and its preference charge comes in front of the Western Union Company's own bonds. It may be that the position of the stock is not sufficiently appreciated for it to be as popular as the yield would appear to warrant, and 110 would not appear to be an excessive quotation.

The Cable and Wireless 5½ per cent. preference stock can be bought about 104 to return £5 5s. 10d. per cent. In this case the security, on the figures last published, is good enough to warrant the stock being included in any list of investments for mixing purposes.

Dollar Stocks

Dollar stocks, more particularly those connected with the United States, have recovered to some extent from the unpleasant rebuff they sustained upon the proposal put forward in Washington for limiting dividends to 6 per cent. The bare suggestion shook the Wall Street market rather badly, and although the proposal appeared, on the face of it, to be fantastic, it would seem as though its sponsors intended to carry on with their intention. The matter has been shelved, however, according to the latest New York advices, until the beginning of next year, when the Bill will be drafted. Should it be passed, it is not likely to operate for some considerable time. During the period of suspense, however, the possibility of its becoming law will act as a deterrent to investment, or to speculative investment, in stocks and shares in American companies upon which the dividends at present exceed the 6 per cent. maximum which is proposed.

South American Issues

The United States has offered Brazil financial assistance in the shape of a Lease and Lend Bill on the same lines as that affecting the United Kingdom, and a general rise in Brazilian issues followed upon the announcement. Rio Trams 5 per cent. bonds followed their last week's gain of 5 points by adding another 4, bringing the price to 92½ ex the recently paid coupon. Brazilian Tractions are a point to the good at 11½. Argentine stocks have come further into favour and Anglo-Argentine Tramways issues present a firmer front on buying that is said to emanate from Buenos Aires.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specifications (1s. each) can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1939

22156. "Light applicators." E. A. Neugass. March 9th, 1939. (539448.)

31167. "Cameras provided with photo-electric exposure meters." W. H. A. Thiemann (P. E. Henriksen). November 30th, 1939. (539450.)

31846. "Automatic temperature control systems for electric heating appliances." American Thermometer Co. December 23rd, 1938. (539481.)

31972. "Electrical speedometers." Stewart-Warner Corporation, and H. M. Norman. December 11th, 1939. (539451.)

1940

328. "Electric rotary switches." C. A. Turner, and Diamond H. Switches, Ltd. January 5th, 1940. (539387.)

673. "Electrical impedances." Reliance Electrical Wire Co., Ltd., and K. Konstantinowsky. January 11th, 1940. (539511.)

2184. "Electron discharge devices." W. S. Brown. February 5th, 1940. (539419.)

2249. "Electrical control systems." C. F. Webb and N. E. Brewerton. February 6th, 1940. (539420.)

2297. "Arrangements for producing concentrated beams of electrons particularly for electron discharge apparatus of the velocity modulation type." Standard Telephones & Cables, Ltd., and J. H. Fremlin. February 6th, 1940. (539422.)

3876. "Operating circuit for gaseous electric-discharge devices." British Thomson-Houston Co., Ltd., H. R. Ruff and M. G. Clarke. March 1st, 1940. (539393.)

4120. "Method and apparatus for electrically pickling stainless steels." F. B. Dehn (Sharon Steel Corporation). March 5th, 1940. (539424.)

4262. "Automatic voltage regulators." Ferranti, Ltd., and E. D. T. Norris. March 7th, 1940. (539434.)

4361. "Electrical networks." Standard Telephones & Cables, Ltd., and B. B. Jacobsen. March 8th, 1940. (539444.)

4494. "Alternating current electric switchgear." A. Reyrolle & Co., Ltd., A. Allan and W. Anderson. March 11th, 1940. (539484.)

4523. "Thermostatic control devices." British Thermostat Co., Ltd., and J. E. Sherlock. March 11th, 1940. (539460.)

4546. "Electron discharge arrangements employing electron beams." Marconi's Wireless Telegraph Co., Ltd. March 10th, 1939. (539490.)

4564. "Manufacture of blocking layer electrode systems." Philips Lamps, Ltd. March 14th, 1939. (539491.)

4565. "Radio-gramophones." Philips Lamps, Ltd. March 14th, 1939. (539492.)

4572. "Suction cleaners." Hoover, Ltd. April 8th, 1939. (539495.)

4602. "Screw-thread gauges." Standard Telephones & Cables, Ltd., and F. G. S. Powell. March 12th, 1940. (539517.)

4614. "Coating glass tubes with luminescent materials." General Electric Co., Ltd., L. F. Britten, H. G. Jenkins and A. H. McKeag. March 12th, 1940. (Addition to 530531.) (Cognate application, 17940/40.) (539520.)

5066. "Circuit arrangements for operating electric-discharge lamps." British Thomson-Houston Co., Ltd., and W. J. Scott. March 19th, 1940. (539465.)

5662. "Street lighting fittings." Ferranti, Ltd., and J. H. Watkiss. March 29th, 1940. (539472.)

5697. "Electric firelighting apparatus." W. Lorch, and Elga Products, Ltd. March 29th, 1940. (Addition to 533742.) (539473.)

5745. "Bonding of refractory material." O. G. Bennett and L. B. Berger. April 18th, 1939. (539474.)

5854. "Ultra-high-frequency antennæ." Marconi's Wireless Telegraph Co., Ltd. March 31st, 1939. (539398.)

5869. "Mosaic electrodes for television transmitting tubes." Mullard Radio Valve Co., Ltd. April 3rd, 1939. (539496.)

5903. "Electric switch apparatus with safety doors or coverplates." G. Adcock and H. Shipley. April 2nd, 1940. (539497.)

6054. "Adjustable connector for tubular conductors." Marconi's Wireless Telegraph Co., Ltd., and R. A. Nightingale. April 3rd, 1940. (539498.)

6124. "Anti-dazzle devices for lamps." Notek Electric Co., Ltd., and R. P. H. Hinds. April 4th, 1940. (539499.)

6290. "Electrical storage and delay circuits." B. M. Hadfield. April 8th, 1940. (539501.)

6483. "Bipolar electrolysers." Maschinenfabrik Oerlikon. December 14th, 1939. (539503.)

6676. "Radio navigation systems." Marconi's Wireless Telegraph Co., Ltd. April 12th, 1939. (539505.)

7091. "Electric circuit-breaker contacts." General Electric Co., Ltd., L. W. Holtom and C. J. O. Garrard. April 19th, 1940. (539526.)

7240. "Refrigerating apparatus." British Thomson-Houston Co., Ltd. April 22nd, 1939. (539401.)

7241. "Refrigerating apparatus." British Thomson-Houston Co., Ltd. April 22nd, 1939. (539527.)

7495. "Electric impulse counters." Boulton Paul Aircraft, Ltd., and J. H. Cox. April 26th, 1940. (539406.)

7786. "Bearing arrangements." Sangamo Weston, Ltd., and M. S. Snell. April 30th, 1940. (539409.)

7838. "Sound recording." L. Thompson. May 1st, 1940. (539534.)

12160. "Manufacture of ball bearings or roller bearings." Philips Lamps, Ltd. March 9th, 1939. (Divided out of 538289.) (539411.)

1941

10209. "Radio bearing or position indicating systems." Sperry Gyroscope Co., Inc. December 9th, 1941. (Divided out of 539321.) (539475.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Bridgend.—October 22nd. Electricity Department. Outdoor type switchgear and transformers. (September 26th.)

Eire.—WATERFORD.—October 13th. Supply and erection of an electrically-driven and automatically-controlled air lift pumping plant at Waterford Mental Hospital, together with necessary wiring, etc. A. Fitzgerald, resident medical superintendent, Offices, Waterford. (Deposit £1.)

Plymouth.—October 11th. Electricity Supply Department. Overhead travelling crane. (September 26th.)

South Africa.—SALISBURY. (S. RHODESIA).—City Council. October 27th. Switchgear, transformers and reactors, together with auxiliary apparatus. (August 29th.) 90,000 lb. overhead electric travelling crane. (September 26th.)

POST OFFICE.—December 4th. Equipment for radio-telephone link between Maseru and Mokhotlong.

Twrcelyn.—October 14th. Rural District Council. Duplicate horizontal, motor-driven, seven-stage, turbine centrifugal pumps, each to lift 6,000 gal. per hr. against 330 ft. head, complete electric automatic starting and control apparatus, and distant water level transmitter at reservoir to govern the running of the plant. Contract No. 5. Particulars from Henry Adams & Son, civil engineers, Fron Heuloy, Bangor, North Wales.

Orders Placed

Australia.—MELBOURNE.—City Council. Accepted. Twelve months supply of electric lamps: Ensign Lamps (Aust.) Pty., Ltd.; S. J. Mathews; British General Electric Co. Pty., Ltd.; H. Rowe & Co. Pty., Ltd.; Siemens (Aust.) Pty., Ltd.; Noyes Bros. (Melb.), Ltd.

Basingstoke.—Town Council. Accepted. Outdoor type 50-kVA transformer (£80).—Electric Construction Co., Ltd.

Blackpool.—Emergency Committee. Accepted. 48-kW petrol-driven generator set.—P. R. Engineering Co.

Transport Committee.—Accepted. 54 batteries for omnibuses.—Chloride Electrical Storage Co., Ltd.

Bootle.—Finance Committee. Accepted. Renewal of contract for cable and flexible cord for twelve months.—Liverpool Cable Co., Ltd.

Emergency Committee. Accepted. Shelter heating.—Liverpool Corporation Electricity Department.

Durham.—County Assistance Committee. Accepted. Electric motor fan and starter at Stockton Institution.—Keith Blackman, Ltd.

Glasgow.—Transport Committee. Accepted. Electric canteen equipment.—English Electric Co. Electric battery lamps.—Thomas Scott & Co.

Police Committee. Accepted. Main transmitter house to be erected in connection with the police radio scheme. (£3,363.)—Robert W. Stewart & Co., Ltd.

Manchester.—Health Committee. Accepted. Switchboard extension and additional telephone instruments at Withington Institution.—New Era Time & Telephone Systems, Ltd.

Electricity Committee. Accepted. Reconstruction of 33-kV neutral earthing resistor.—Rheostatic Co., Ltd. Work in connection with the change-over from DC to AC.—E. M. Evans & Sons, Ltd.

Transport Committee. Accepted. Three miles of cadmium copper trolley wire.—Richard Johnson & Nephew, Ltd.

Salford.—Lighting Committee Recommended. Transformers (£2,000.)—Bryce, Ltd.

South Africa.—RAND WATER BOARD.—Two 4,000-kVA and two 5,500-kVA transformers for pumping stations (£18,800).—Metropolitan-Vickers Electrical Export Co.

Warrington.—Corporation. Accepted. E.h.v. and l.v. cables.—British Insulated Cables, Ltd. Twelve months' supply of earthenware conduits.—Doulton & Co., Ltd. Reinforced concrete cable protector slabs, tiles and covers.—H. J. Baldwin & Co., Ltd. Fire protection equipment.—Mather & Platt, Ltd.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Blackpool.—Auxiliary bus station; transport manager.

Shop; J. Pullar & Sons, Ltd.

Brighton.—First-aid post (£3,298) and A.R.P. vehicle garages (£2,303); borough engineer.

Chesterfield.—Sewage and sewage disposal works (£99,400); J. B. Wikeley, engineer and surveyor, The Rural District Council House, New Beetwell Street.

Chester-le-Street.—British Restaurant; U.D.C. surveyor.

Colchester.—Cleansing centre; G. T. Morris, architect, St. Peter's Chambers, High Street.

Coventry.—Additions to works; A. H. Coltman & Son, builders, Barker Butts Road.

Hall at Canley Youth Centre, Queen Margaret's Road (£8,035); Bosworth & Wakeford, Ltd., builders, New Street, Daventry.

Durham.—Rest centres and shelters; county architect.

Dunblane.—Fire station; burgh surveyor, Burgh Chambers, The Cross, Dunblane.

Ealing.—Alterations for Candy Filter Co., Ltd.; Davis & Co., builders, 22, Boston Road, Hanwell, W.7.

Canteen for Kidde & Co., Ltd.; P. Bilton, Ltd., builders, 66, Greystoke Avenue, Pinner.

East Boldon (Co. Durham).—Three hostels; N. Hindmarch, U.D.C. surveyor.

Edinburgh.—New ward kitchen and laboratory at Western General Hospital; city architect.

Eire.—DUBLIN.—Houses (312) at Cabra West housing site; Corporation architect, 5, Wellington Quay, Dublin.

Enfield.—Canteen and store, Express Motor Body Works, Gt. Cambridge Road; L. Robinson.

Factory extension; G. Payne Construction Co.

Cable store, Sterling Cable works; Heffer & Smith.

Three restaurants (£3,650) and school emergency feeding centres (£1,410); U.D.C. surveyor.

Café, Queensway; F. J. Baxter.

Gateshead.—Conversion of Holy Trinity Church into nursery (£600); F. H. Patterson, borough engineer.

Godmanchester.—Fire station; borough surveyor, Town Hall, Godmanchester, Huntingdon.

Grimsby.—Gymnasium, &c., at Victoria Street Youth Centre, bathroom and showers at Remand Home, school canteen at Chapman Street, and nursery class at Strand Street School; L. W. Heeler, town clerk, 9, New Street.

Harpenden.—Rebuilding St. Margaret's Home; Claridge & Hall Bros., Ltd.

Huntingdon.—Houses for R.D.C.; surveyor Rural District Council Offices.

Jarrow-on-Tyne.—Another British Restaurant; J. S. Weir, borough engineer, Town Hall, Jarrow.

Keswick.—Conversion of casual ward into nursery, for Cumberland C.C.; J. H. Haughan, county architect, 4, Alfred Street North, Carlisle.

Liverpool.—Canteens (£40,000); Mersey Docks and Harbour Board.

London.—BATTERSEA.—Shelter improvements (£4,100); borough engineer.

LEWISHAM.—Cleansing stations, Bromley Road and Burnt Ash Road (£3,000); Henry Kent, Ltd., and T. W. Driver, Ltd.

POPLAR.—Shelter improvements (£25,000); Crispin & Borst; Halse & Sons; Richardsons, Ltd.; Bradford & Sons, Ltd.; G. Anderson; Reader Bros.; and E. A. Roome & Co.

ST. PANCRAS.—Shelter improvements (£65,000) and cleansing stations (£1,160); borough engineer.

Lowestoft.—Restaurant, Lovewell Road; borough engineer.

Control centre (£1,975); D. Leighton & Son.

Manchester.—Extensions to restaurant; G. Noel Hill, city architect, Town Hall.

Mansfield.—Kitchen (£725); borough engineer.

Middlesbrough.—Extensions to Remand Home; C. Gorman, borough engineer, Town Hall, Middlesbrough.

Offices, Atlas Street, for Wood & Sons.

Brick shelters at 12 more schools; F. Mellor, education architect.

Canteens at the Kirby and High Schools; F. Mellor, education architect, Woodlands Road.

Millom (Cumberland).—British Restaurant; R.D.C. surveyor.

Northumberland.—Remand home; county architect, Mitford Road offices, Morpeth.

Pudsey.—Adaptation of Providence House, Sunfield, as nursery; borough surveyor, Town Hall.

Reading.—Workshops for trolley vehicles, Mill Lane transport depôt; borough surveyor, Town Hall.

Repton.—Construction of a pumping house at sewage works for R.D.C. (£2,550); A. P. Hancock, engineer, The Poplars, Rolleston Road, Burton-on-Trent.

Ryde.—Pumping unit at Canoe Lake; borough surveyor, 5, Lind Street.

Salford.—Adaptation of four flats, Langworthy estate, as wartime nursery; W. A. Walker, borough surveyor, Town Hall, Salford, 3.

Skelton (Yorks).—Adaptation of cinema at Carlin How as community feeding kitchen; U.D.C. surveyor.

Southgate.—Cleansing stations, Grovelands (£999); Tarran Industries, Ltd.; Keble School (£1,204); Stapleton & Sons, Ltd.

Stoke-on-Trent.—Houses, Pool Street, Fenton; Queens Road, Hanley; and Longport Road, Longport; G. H. Wignall, Ltd.

Day nursery, West End; city engineer.

Feeding centre, Stoke market, and extensions to Remand Home, Stanley Terrace, Tunstall; city architect.

Stourbridge.—Adaptation of premises in Talbot Street, Lye, for British Restaurant; G. N. Maynard, borough surveyor, The Council House, Stourbridge.

Sunderland.—Pump house; A. G. Royle, engineer and manager, Corporation Electricity Department.

Urmston.—Canteens at public shelters, and emergency feeding centres on five sites; surveyor, U.D.C. Offices.

Wellingborough.—British Restaurant; R. Kilby, surveyor, Council Offices, Swanspool, Wellingborough.

Extensions to kitchens, Park Hospital (£585), for Northants Public Assistance Committee.

Wellington (Salop).—Fire station and quarters at Donnington Wood for R.D.C.; Parsons and Morrin, Ltd., builders, 133, Belgrave Road, Birmingham, 5.

Wellington (Somerset).—British Restaurant, Wiveliscombe, for R.D.C.; surveyor, Rural District Council Offices.

West Bromwich.—Restaurant, Hill Top, and hostel, Beeches Road; borough engineer.

Whitley Bay.—British Restaurant, Front Street, Monkseaton; A. J. Rousell, surveyor.

Woking.—Thirteen wardens' posts, for U.D.C.; G. F. Hawkins, surveyor, Council Offices.

Wolverhampton.—Works additions; J. Mytton. Workshop, Hilton Street; Wright Bros., Ltd.

Extensions, 159, North Street; T. J. Barnett & Sons.

Youth centre, Low Hill, and restaurants (£12,082); borough engineer.